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Engineering News-Record

The story of the remarkable progress in water-supply engineering since its pioneer beginnings is one of the classics of engineering history.

Throughout this development of nearly a century modernization has been the dominant keynote. The plant of 1880 became the plant of 1890 through application of new knowledge and utilization of new materials and equipment. The old pioneers, many of them members of the New England Water Works Association, which holds its 50th meeting next week, were modernists in every sense of the word. They embraced new ideas. They developed new methods. They built for the future.

Waterworks Modernization

Today, though ample supplies of soft, clear and pure water are at the command of nearly everyone, the need for waterworks modernization is as great as ever.

In purpose this issue is dedicated to modernization. In plan it presents a series of articles that take stock of existing knowledge and facilities. By such survey of our position on the road of progress the course that modernization can and will follow in the future should become increasingly clear.

Articles in This Issue:

Water Distribution System Development
By F. H. Stephenson

Modernization of Distribution Accessories
By H. W. Griswold

Designing the Modern Pumping Station
By Charles B. Burdick

Economy of Modern Pumping Equipment
By W. M. White

Great Hydraulic Engineers of New England
By Charles W. Sherman

Fayette F. Forbes—Dean of New England Waterworks Superintendents

Concord, N. H., Drives 150 New Wells

Architecture of the Waterworks Plant
By Victor A. Matteson

New Electric Pumping Plant at Pittsburgh
By Ross M. Riegel

Detroit's Novel Lagoon-Protected Intake
By Torris Fide

Water Plant Holds Industries in Small Town
By Burton Lowther

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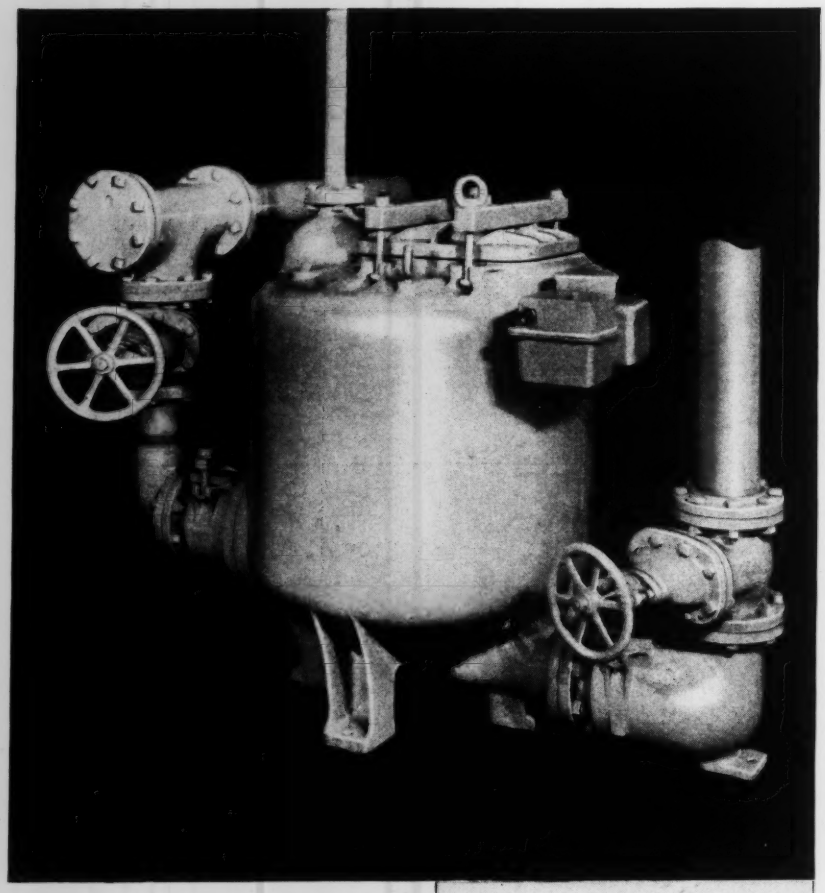

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ENGINEERING NEWS-RECORD

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F. E. Schmitt, Editor

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"To Exchange Ideas"

NEARLY fifty years ago a call was sent out to the waterworks superintendents of New England to meet in Boston. The object was to form an association "to meet once or twice a year to exchange ideas." As the outcome of this call the New England Water Works Association was founded. Next week, when the association holds its fiftieth meeting—again in Boston—it can look back on a long career of success in utilizing such exchange of ideas as a means of advancing the art of water supply. Throughout its existence the association itself, as well as its members, has been serving the cause of waterworks modernization, which is the main theme of this issue of *Engineering News-Record*. Even before the association's birth the same theme motivated the work of many notable pioneers in hydraulics, when the science was in its infancy. Because this early group flourished in New England and because the era is a classic period in our national engineering history, we present a series of sketches in our leading article to recall how these pioneers worked. They too were inspired with the ideal of modernization.

Looking Ahead

GERARD SWOPE'S publication of a plan to provide for the security of the industrial worker is one of the best pieces of news that has come out of industry in many months. Short-range thinking has been common, but the proposals of the president of the General Electric Co. in his address to the National Electrical Manufacturers' Association prove that some leaders of industry are looking ahead, not mourning about depressed business but orienting their plans on the future. His proposals are intended not to cure the present depression but to help industrial stability in good times and bad. That the future is sure to be greater than the past is primary doctrine; that it must be a more efficient and a better future is equally undeniable. Any plan that will help to attain this better state by making the world's work more permanent and stable is important. Mr. Swope's plan aims at stability and human confidence. That is why it is progressive and why, whether perfect or imperfect, it is likely to be the starting point of new industrial advance.

Partners in Industry

CONTRACTORS have done little thinking on human relations, and will find it profitable to follow closely the new line of thought. Industrial leaders are concerned over stability of employment, old-age and pension problems. Mr. Swope's plan brings this attitude of mind into the spotlight. Under his plan the worker's partnership in the production enterprise would be recognized not merely within one company but throughout the full range of the industry involved. Included in the plan are compulsory life and disability insurance, retirement accumulation and unemployment insurance, so set up as to follow the worker from plant to plant. The investments would be administered by a joint board and there would be a federal supervisory body for control. All this sounds startlingly radical, and it is radical; but coming from a manufacturer who employs tens of thousands of men it is evidently the outgrowth of a desire to discover what is good business. Mr. Swope's basic conviction appears to be that industry cannot count on permanence or even stability unless it removes from the worker's mind the disorganizing influence of fear for his job and anxiety over old age. Is construction so different that these considerations have no legitimate application to its problems?

Local Labor

IN THE nationwide task of putting unemployment relief work under way for the coming winter few communities will find themselves so self-contained that they will not need the cooperation of others. Unemployment is a general and not a local problem. This principle is well emphasized in a statement of the federal labor department, which rests its recommendations on the fact that "unemployment is not a local matter and can best be limited by *making labor as mobile as possible*." In connection with the public-works construction that will be one of the chief means of relieving unemployment this coming season, there is an insistent and growing demand that employment on public work be restricted to local residents or citizens. Widespread acquiescence in these demands will result in benefit to a few with increased hardships for many. Carried to a possible extreme, Third Ward residents alone could build the new Third Ward school. Occupational limitations are hardship enough to the unemployed without subjecting him to geographical limitations. The national unemployment situation cannot be met with local restrictions.

Adding to Their Difficulties

AN ORDER from the Interstate Commerce Commission to the railroad and telephone companies to follow a uniform system of setting up depreciation reserves after Jan. 1, 1933, adds to the difficulties of railroad managers. The telephone companies are not greatly affected, as they already use a similar system. As for the railroads, they set up depreciation reserves for their equipment some years ago, but all other property has generally been cared for by a replacement system, costs of replacements made each year being charged against earnings instead of setting up a depreciation reserve by annual charges against earnings. Annual renewal

of those track ties that appear to have reached the end of their service life (the number varying somewhat each year), is an example of how the system worked. Accountants doubtless do not like the system because it results in charges that vary from year to year as actual rather than theoretical considerations dictate, but if the cost of the replaced ties is charged against earnings and any increased cost of the new over the old is charged to capital the system is sound as well as simple. If the more elaborate system now specified were extended to large bridges and buildings, it might possibly be shown to have advantages, but its extension to railroad track and small structures may easily cost more in disarrangement of present methods than it is worth.

Waterworks Modernization Through the Decades

SINCE the days of the pioneers remarkable progress has been made in the engineering arts that provide our water supplies. Today water is served to thousands of communities, from great metropolitan centers down to small villages. It is not delivered in its crude state but is refined to adapt it to all uses. Its foreign burden is precipitated by coagulating chemicals; its content of objectionable mineral salts is reduced by softening agents. It is rendered sparklingly clear by filtration. Carbon dioxide gas stabilizes its chemical status. Finally, it is made completely safe by sterilization. Only when it has gone through these processes is it distributed. Powerful pumps of small compass force it through many miles of mains—of iron, steel or concrete, and occasionally of wood—to place it at the command of every household. This complex art has grown out of the simple water-supply efforts of early days by engineering evolution.

WHAT has been gained is first of all the habit of using water freely, leading to universal cleanliness. Far more important, we have gained thoroughgoing protection from waterborne diseases—to such a point that ever typhoid, chief among them, is unfamiliar to many physicians. These gains are the result of barely half a century's work. The chief activity in building supply systems, and all of that rich development which marked the rise of water purification, was accomplished since the seventies and eighties of the last century. Much of these achievements is the work of a generation still living.

A quantitative measure of the value that has flowed from the progress of water-supply engineering is probably unattainable. In terms of reduction in disease and suffering it is vast; expert statisticians can approximate this achievement by comparison of the mortality records of waterborne diseases in former years and today. But beyond this lies the unmeasured amelioration of the habits and comforts of many tens of millions that ample and safe water service has brought about. The total reckoning, though it escapes computation, is great enough to constitute a solid satisfaction to all who have devoted their lives to the improvement of the art. The engineers of the past half-century have wrought well for their fellowmen.

IT WAS just fifty years ago that Koch, in his series of demonstrations of the connection between bacteria and disease, devised the solid culture media with which pathogenic organisms could be isolated, and thereby facilitated the discovery of the typhoid bacteria. Although Koch himself in 1883 traced the origin of a cholera epidemic to the source of water supply, the world at large awoke to the health dangers arising from polluted water only in 1892, when the dreadful Hamburg cholera outbreak occurred. That epidemic, by leaving untouched the neighboring suburb of Altona, which filtered the supply that it drew from the same grossly polluted Elbe, taught the lesson in unmistakable terms.

CLEAN water had always been valued, but with only the vaguest notions of what the term should mean. These positive demonstrations of the definite connection between bacterial pollution and disease at last gave definite orientation to water-supply improvement. A standard was available with which to measure the efficacy of purification processes. Filtration through sand, first used as an imitation of the natural filtration experienced by groundwater, became recognized as a bulwark against bacteria; correspondingly, its performance could be subjected to quantitative test. Sedimentation became more than a means of removing suspended turbidity, and was utilized to decrease the bacteria load.

And so, in progressive developments, the purification processes grew to what we know today as modern methods. Economies in construction and operation soon claimed attention, stimulating the development of rapid filtration, with coagulation as an indispensable aid. Industry's water requirements, which met many operating difficulties from the presence of hardness-forming compounds, led to the adoption of softening methods. Chemical sterilization came into being in an effort to cope with grossly polluted water sources, and later became recognized as a legitimate adjunct to all purification processes. The widespread use of sterilizing chemicals introduced new problems of taste-and-odor control, which are only now being solved.

LOOKING backward in this way, it is seen that a long road has been covered. Forward, however, equal growth remains, and equal problems face us. In our issue of May 22, 1930, the indicated trends of the near future in waterworks practice were discussed in detail. In the present issue we intend to pause for a moment in the march toward unknown developments to appraise the immediate task, summed up in the word *Modernization*.

We seek to examine not alone the modernization of water-treatment plants but also the methods, materials and equipment by which technical knowledge and skill makes better water service available to the citizen. In every branch, water supply has experienced profound changes within the past fifty years, but these changes have received all too little attention in the constant haste to apply the latest available knowledge. By stopping now to examine the point at which we have arrived, and observing the work and throught being devoted to further progress, we may better value the future course of the continued efforts to provide adequate, safe and agreeable supplies of water.

Great Hydraulic Engineers of New England's Classic Period

Men who laid the foundation of the water supply and power arts in America, from Loammi Baldwin and Samuel Storrow to Herschel and Freeman

By CHARLES W. SHERMAN
Of Metcalf & Eddy, Engineers, Boston

CONSIDERATION of the development of hydraulic science and waterworks engineering in the United States shows that a large proportion of the advance made during the nineteenth century was accomplished in New England. The great engineers who brought about this advance are too little remembered in the present generation.

Before 1800 comparatively little was known about hydraulics, and nearly all the experimental and theoretical research had been done in Italy, France and Germany. What little hydraulic work had been done in this country related to crude waterpower developments, canals for transportation and a few small city water supplies. Probably no more scientific investigation accompanied it than such, for instance, as Washington was able to apply to the canal in which he was so intensely interested. But beginning soon after this date, American engineers made a continuous succession of great contributions to the art. The present brief notes on some of these men may help to bring their work to wider knowledge of the engineers of today.

In the field of experimental and theoretical hydraulics, the accomplishments of Francis, Mills, Fteley and Stearns, Ellis, Freeman, Herschel, FitzGerald and Hazen account for much of the advance made in this country. In the development and testing of hydraulic turbines the names of Francis, Boyden, Emerson and Herschel are outstanding. In matters relating to sources of water supply, their sufficiency and development, Baldwin, Chesbrough, Davis, Fteley, Stearns and FitzGerald were prominent. Quality of water and its improvement by filtration or other processes were the field of Mills, Nichols, Drown, Sedgwick, Stearns, FitzGerald, E. B. Weston, Hazen and Whipple. E. D. Leavitt had a prominent place in the development of waterworks pumping engines, and Dexter Brackett in studies of water consumption and practical work on the restriction of waste. In the design and construction of waterworks systems, Fanning, Brackett, Freeman and Coffin take primary place.

An engineer whose name is less widely known than most of those mentioned above but who deserves greater recognition than has ever been given him is Charles S. Storrow, whose little book "A Treatise on Water-Works for Conveying and Distributing Supplies of Water," published in Boston in 1835, first made known to American engineers the researches and formulas of French experimenters. Possibly the complicated appearance of many of the formulas quoted by Mr. Storrow and the free use which he made of calculus may have deterred American engineers from giving the book the attention it deserved. But it should be remembered that few waterworks were being built in these early days, the number increasing from 16 in 1800 to 83 in 1850, mostly small plants.

Brief biographical sketches of some of the most important contributors to hydraulic science in New England follow.

Loammi Baldwin
1780-1838

Mr. Baldwin was described in 1885 by Prof. George L. Vose as better entitled than any other man to be called the "Father of Civil Engineering in America." He was a son of Col. Loammi Baldwin (1745-1807), who served in the Continental army under Washington and later devoted most of his energies to the construction and operation of the Middlesex Canal. Loammi Baldwin II, therefore, had ample opportunity to become interested in scientific matters. He was graduated from Harvard in 1800, and in 1807 he went to England to study public works, and on his return opened an office in Charlestown as a civil engineer.

Like other engineers of the time, he practiced in all branches of the profession, including the design and construction of fortifications, canals, railroads, mill dams, bridges, docks and buildings. The engineering structures built by Mr. Baldwin which are best known are the naval drydocks at the Boston and Norfolk navy yards. These are fine examples of cut stone construction, as sound today as when they were built a century ago.

As the leading engineer of his time in America, he was called to assist the committee charged with studying

Loammi Baldwin

"Father of civil engineering in America." Made a notable report on a water supply for Boston in 1834.

the possibilities of a water supply for the city of Boston in 1834. The amazing thing is the remarkable report which Mr. Balwin prepared in less than five months (City Document No. 12 of 1834).

He describes the various methods for procuring water, six pages being required for the account of artesian or bored wells, and 26 pages for acqueducts.

He then comes to the subject of a water supply for Boston, and of bringing in or at least gaining control of 5,000,000 gal. daily. He states that there are many ponds within the distance of about 20 miles, from which a supply of pure water may be had, by its natural flow to ground within 4 or 5 miles of Boston, sufficiently elevated to deliver water by gravity to the highest points of the city even to the floor of the State House.

After describing fourteen different ponds he says that "the most eligible are those of Farm and Shakum ponds in Framingham, together with incidental ones dependent upon them; and Long Pond in Natick." The latter, afterward called Lake Cochituate, is the one from which the supply was finally taken, in 1848.

The report then gives Baldwin's idea of the route to be taken, with a description of each section, and the cost of the whole, which he estimates at $750,000, not including the distribution in the city, as that must depend on the quantity distributed.

Charles Storer Storrow
1809-1904

Mr. Storrow was a graduate of Harvard in the class of 1829. He then went to Paris and studied for more than two years in the Ecole Polytechnique and the Ecole des Ponts et Chaussées. Returning to America in 1832, he became assistant engineer to Loammi Baldwin, and shortly thereafter he wrote "A Treatise on Water-Works for Conveying and Distributing Supplies of Water; With Tables and Examples" (Boston, 1835). This "was the first treatise on hydraulics in the English language. It made available for the first time to English-speaking engineers the work of the French writers Prony, Belanger and others." (*Engineering News*, May 5, 1904, p. 423.) Besides a few diagrams in the text there were two plates of details of pipe joints, valves and pumps, some of which are here reproduced, followed by explanatory remarks from the text.

Charles Storer Storrow

Author of "A Treatise on Water-Works," 1835, "the first treatise on hydraulics in the English language."

James Bicheno Francis

Of weir and turbine fame. Published "Lowell Hydraulic Experiments," 1855.

While assistant engineer to Mr. Baldwin Mr. Storrow was engaged on the construction of the Boston & Lowell R.R., the first steam railroad in New England. Later he was made its general manager, a position which he held until 1844. During this period he made measurements of the water used for power at Lowell, Mass., and later was influential in having James B. Francis appointed to continue the work.

In 1844 Mr. Storrow was appointed engineer of the Essex Company, which was about to undertake the development of the waterpower at Lawrence, Mass.

In 1846, when the Lawrence scientific school of Harvard University was founded by Abbot Lawrence (largely as a result of Mr. Storrow's statements to him about engineering schools of Europe), the professorship of engineering was offered to Mr. Storrow, who declined it. Later he was a memeber of a state commission to investigate the condition of the Sudbury and Concord rivers; and afterward he was sent to Europe by the state to investigate the use of compressed air in tunneling, with a view to accelerating work on the Hoosac tunnel.

James Bicheno Francis
1815-1892

Born at Southleigh, England, Mr. Francis came to America in 1833. A year later he was in the machine shop of the Proprietors of Locks and Canals on Merrimac River (at Lowell, Mass.), and in 1837 on the recommendation of Mr. Storrow, he became engineer of the company. In 1845 he was appointed "agent" (general manager) as well, and held both positions until 1885, after which date he continued to serve as consulting engineer to the company until his death. From 1850 to 1890 he probably ranked as the most eminent hydraulic engineer in America.

The publication of his "Lowell Hydraulic Experi-

ments" in 1855 brought to the attention of engineers everywhere the remarkable experimental work which Mr. Francis had carried on. In particular, his formula for flow over weirs, $Q = 3.33Lh^{3/2}$, which is still accepted as a standard formula notwithstanding a great deal of later experimentation and the presentation of other formulas, made his name familiar throughout the hydraulic world.

In addition to the work reported in "Lowell Hydraulic Experiments" Mr. Francis made important contributions to hydraulic literature through papers, discussions and reports. In particular, attention should be called to a number of papers in the *Transactions* of the American Society of Civil Engineers; on "Experiments on Flow of Water Over Submerged Weirs," Vol. 13; "Experiments on the Humphrey Turbine Waterwheel at the Tremont and Suffolk Mill in Lowell, Mass.," Vol. 13; "On the Cause of the Maximum Velocity of Water Flowing in Open Channels Being Below the Surface," Vol. 7; "Distribution of Rainfall During the Great Storm of Oct. 3-4, 1869," Vol. 7; "High Walls or Dams to Resist the Pressure of Water," Vol. 19; "Report of the Committee on the Cause of the Failure of the South Fork Dam" (Johnstown, Pa.), Vol. 24.

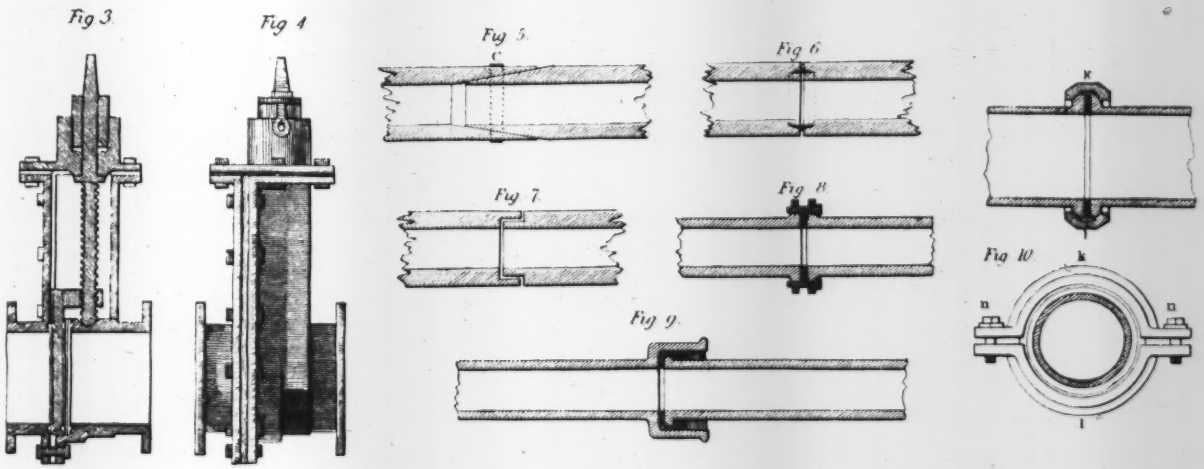
Likewise worthy of mention is his "Report of the Commission of the Prevention of Floods in the Valley of Stony Brook" (with Eliot C. Clarke and Clemens Herschel), Boston City Document 1886. A third edition of his "Lowell Hydraulic Experiments" appeared in 1883. Mr. Francis was also prominently identified with the development and rating of the turbine waterwheel. His influence upon the development of hydraulic science in America may doubtless be stated to have far exceeded that of any other man.

Uriah Atherton Boyden
1804-1879

Mr. Boyden is known principally as the inventor of a number of improvements in turbine waterwheels and of the hook gage. In his early life he was a leather splitter and had a shop in Cambridge. Later he became interested in scientific subjects and was a student in the office of Loammi Baldwin in Charlestown. In 1838 he was engineer of the Nashua & Lowell R.R., but after about 1840 devoted himself mainly to hydraulics. He accumulated a "considerable fortune" from the sale of his patents. On his death he bequeathed about $230,000 to Harvard College, which was used in establishing an astronomical observatory in Peru.

Ellis Sylvester Chesbrough
1813-1886

Mr. Chesbrough did a substantial amount of his important hydraulic work for Boston, although his later professional reputation was more as an expert in sewerage and sewage disposal, based largely on his work in Chicago and as consultant for many of the largest cities in this country. He was born in Maryland and had but little schooling, and his early work in engineering (1828-1846) was mainly on railroad construction. In 1846 he was chosen engineer for the western division of the Boston waterworks, and had charge of the design and construction of the works for obtaining water from Lake Cochituate. In 1851 the Cochituate Water Board appointed him city engineer of Boston, an office which



Valve and various kinds of pipe joints a century ago

From a "Treatise on Water-Works," by Charles S. Storrow, published at Boston in 1835. Extracts relating to the cuts here reproduced follow:

It is highly important that the short pipes, of which the conduit is composed, should be joined together in the most perfect manner. When they are of wood, it may be done in the manner shown in Figs. 5, 6, 7, of Plate I. Fig. 5 is the most common. The end of one pipe is enlarged, and the end of another sharpened so as to enter into it. The joint is strengthened by an iron strap *C*. In Fig. 6, a ring is made sharp at the edges, and enters the butt of each pipe. Fig. 7 shows another kind of joint. With all of them, tow should be carefully stuffed in between the pieces to make them tight.

When wooden pipes of considerable diameter are required, they may be made of staves bound with iron hoops. In some instances planks have been bent by steam into the shape of rings and joined together at the edges by rings of iron, as shown in Fig. 6. This has been found to answer very well, and will be very strong if the wood is carefully selected. Leaden pipes are generally connected by soldering. Sometimes a flanch or rim is made around the ends, and they are drawn together by means of screws, which pass through holes in the rims, a piece of soft leather being inserted between them. Cast-iron pipes may be united in various ways. Fig. 8 represents the manner last mentioned for lead, and it has often been used for iron. In order to avoid the necessity of making holes in the rims, the mode shown in Fig. 10 has been adopted. When the two parts of the collar *kl*, which embraces them, are drawn together by the screws *n*, the rims, which are wedge shaped, are forced together. These joints are very strong, but they do not allow the least play, which is a disadvantage. Fig. 9 shows a more approved mode of connection. The end of one pipe being introduced into an enlarged part at the end of the other, tow is first pressed into the opening, and the remainder of the space is then filled with melted lead, which is compressed by hammering. The best mode of stopping up the joint, when lead is to be poured in, is by a ring composed of two semicircular pieces, which are connected by a hinge at one end and can be screwed together at the other. This ring is made to clasp the inserted pipe close to the joint. The lead is then poured in, and the ring not only prevents it from running out but leaves it with a smooth and even surface, so as to render no dressing or chipping necessary around the joint.

Figs. 3 and 4 of Plate II represent a very good kind of stopcock. It consists of a plate, which is made to slide up and down by means of a vertical screw. This screw and plate are in two pieces, so that a slight horizontal motion may take place in the latter, and the water presses it tightly against the end of the pipe. This answers the very purpose perfectly well and is not very expensive.

he filled until 1855 (the principal if not the only function of the city engineer at that time appears to have been to administer the waterworks). During this period he made extensive investigations and valuable reports upon the extent and effect of tuberculation in cast-iron pipes, bringing together a mass of information which appears to include a large part of what is known on this subject at the present time.

In 1855 Mr. Chesbrough went to Chicago as engineer of sewers. Later he became city engineer and soon attained recognition as the leading sanitary engineer in America. He was responsible for the construction of the first waterworks tunnel intakes at Chicago.

Joel Herbert Shedd **1834-1915** Mr. Shedd should be remembered especially because he, more than any other engineer since Baldwin, maintained an office which served as a training school for young engineers. He opened an office in Boston in 1856, specializing in hydraulic and sanitary engineering. Later he removed to Providence, where he was city engineer for a long time, designing and building considerable parts of the water and sewage works of that city.

Joseph Phineas Davis **1837-1917** Mr. Davis was a graduate of Rensselaer Polytechnic Institute in the class of 1856. After working on the Brooklyn waterworks for a few years he was five years in Peru, where he made surveys, plans and reports for water supplies, bridges, railroads, sewerage systems and other public works. Later he was principal assistant engineer on the construction of the St. Louis waterworks. In 1870 he became chief engineer of the Lowell (Mass.) waterworks and had charge of the design and construction of the system.

In 1871 he was appointed chief engineer of the Cochituate (Boston) Water Board, and after an investigation of all available sources recommended the Sudbury River for an additional supply for Boston. The works were carried out under his direction as city engineer, a position to which he was appointed in 1872, Alphonse Fteley being resident engineer of the waterworks. During this period Mr. Davis also planned and began the construction of the Boston main drainage system.

Most of Mr. Davis' later work was for the telephone company and included the design and construction of systems of ducts for underground wires, studies of demand and the like. However, he served as consulting engineer to the Croton Aqueduct Commission, the Massachusetts state board of health and the Metropolitan Water Board of Massachusetts.

Mr. Davis' published contributions to hydraulic and water-supply engineering are found in his reports on the Boston water and sewage works. Many of them are not widely known. A most important part of his work was in inspiring and developing the men who worked under him, several of whom became eminent.

Hiram Francis Mills **1836-1921** Mr. Mills was a graduate of Rensselaer Polytechnic Institute in 1856. For several years thereafter he worked under such men as James P. Kirkwood, William E. Worthen, Storrow and Francis. In 1869 he became chief engineer of the Essex Company, which controlled the waterpower on the Merrimac River at Lawrence. Here he made many hydraulic experiments, especially upon the flow of water in open channels and the distribution of velocities in channels. In 1878 he contributed to the American Academy of Arts and Sciences a paper on piezometers which was of special importance. The results of most of his experiments, however, were not published until after his death.

Mr. Mills' reputation rests chiefly on his long service as a member of the Massachusetts state board of health. Although he received no remuneration, he devoted much time to its work, especially that relating to water supply and sewerage. Under his direction the Lawrence Experiment Station was started and maintained; and the two classic special reports of the board (1890), entitled "Purification of Sewage and Water" and "Examination of Water Supplies," were prepared. With Frederic P. Stearns as chief engineer of the board, Thomas M. Drown as chemist, William T. Sedgwick as biologist and Allen Hazen (and later George W. Fuller, who is still in active practice) in charge of the Lawrence Experiment Station, work was accomplished which served as the foundation for most of the subsequent progress in water and sewage treatment. On the basis of this work Mr. Mills in 1892 built the slow sand filter of the Lawrence waterworks, which resulted in a very large reduction of the typhoid death rate in that city.

Theodore G. Ellis **1830-1883** Mr. Ellis received his early professional training in an office in Boston. In 1854 he went to Connecticut on railroad work, and later to Mexico on mining work. Early in 1861 he was engaged on surveys of Boston harbor. Later he enlisted in a Connecticut regiment, and served through the Civil War, being brevetted brigadier general. After the war he opened an engineering office in Hartford, where he spent the remainder of his life. He made extensive studies of the Connecticut River for the federal government, and also conducted some experiments on the discharge of orifices, reported in a paper "Description and Results of Hydraulic Experiments With Large Apertures at Holyoke, Mass., in 1894" (*Trans.*, Am.Soc.C.E., Vol. 5).

Alphonse Fteley, **1837-1903** Mr. Fteley was born and educated in France. He came to America in 1865 and was located in New York until 1873, when Joseph P. Davis, city engineer of Boston, engaged him as resident engineer in charge (under Mr. Davis) of the design and construction of the works for an additional supply of water from the Sudbury River. He prepared a very complete report on this work, published under the title "Additional Supply of Water, 1883." During the progress of the work Mr. Fteley and his assistant, Frederic P. Stearns, carried out many experiments on the flow of water over weirs and in conduits, which were reported in a paper, "Description of Some Experiments on the Flow of Water Made During the Construction of Works for Conveying the Water of Sudbury River to Boston," *Trans.*, Am.Soc.C.E., Vol. 12. The Fteley and Stearns formula for flow over weirs resulting from these experiments is almost as well known as that of Francis.

In 1884 Mr. Fteley went to New York as principal assistant engineer of the Croton Aqueduct Commission, of which he later became chief engineer, having charge of the design and construction of the works constructed between 1885 and 1889.

John Thomas Fanning **1837-1911** Mr. Fanning served through the Civil War, attaining the rank of lieutenant colonel. After the war he opened an office in Norwich, Conn. He specialized in waterworks engi-

neering and designed and constructed many important works. His most notable achievement was his book, "A Practical Treatise on Hydraulic and Water Supply Engineering," published in 1877, which was the recognized encyclopedia of the subject for the next twenty years. In 1885 he moved to Minneapolis, where he spent the remainder of his life, filling many engagements as consulting engineer on waterworks and waterpower problems.

Clemens Herschel **1842-1930** Mr. Herschel was born in Boston, was graduated at the Lawrence Scientific School of Harvard University (1860) and afterward studied in France and Germany. After serving in various capacities, part of the time in the office of the city engineer of Boston and largely on bridge work, he became hydraulic engineer of the Holyoke Water Power Co. in 1879 and constructed the famous Holyoke testing flume, initiating the long series of tests of hydraulic turbines carried on there. This was in succession to a commercial testing flume previously maintained for some years by James Emerson. Later (1889) he became engineer and superintendent of the East Jersey Water Co., and after 1900 was in consulting practice. He is well known as the inventor of the Venturi meter.

Desmond FitzGerald **1841-1926** Mr. FitzGerald was born in Nassau, Bahama Islands, but moved to Providence, R. I., when quite young. After being graduated from Phillips Andover Academy he entered an engineer's office in Providence and soon afterward engaged in railroad work in Indiana and later on the Boston & Worcester R.R. In 1872 the was made superintendent of the western division of the Boston waterworks

He was a pioneer in starting sanitary surveys and regular sanitary inspections of drainage areas from which water supplies were obtained. He inaugurated and pressed to a successful conclusion the first suit to prevent the pollution of waters used for public supplies; he established the first biological laboratory in connection with a waterworks system and put George C. Whipple in charge of it. He designed and established in 1878 the recording rain gage at Chestnut Hill reservoir. He conducted a long series of experiments on evaporation at the Chestnut Hill reservoir and wrote a paper on this subject (*Trans.*, Am.Soc.C.E., Vol. 15) which is still of marked importance. Other important papers in the *Transactions* were: "Maximum Rates of Rainfall," Vol. 21; "Rainfall, Flow of Streams and Storage," Vol. 27; "The Temperature of Lakes," Vol. 34; "Flow of Water in 48-In. Pipes," Vol. 35. Elsewhere appeared "The Influence of Elevation and Wind Upon Rain-Gage Records" (*Journ.*, Assn. Eng. Socs., Vol. 3); "Rainfall Available for Water Supply" (*Jour.*, N.E.W.W. Assn., Vol. 1); and "Capacity of the Sudbury River and Lake Cochituate Reservoir in Time of Drought" (*Jour.*, N.E.W.W. Assn., Vol. 2).

Edmund B. Weston **1850-1916** Mr. Weston began his engineering work as a student in the office of J. Herbert Shedd, then chief engineer of the Providence waterworks, and remained on these works until 1897. He is best known for his paper, "The Results of Investigations Relative to Formulas for the Flow of Water in Pipes" (*Trans.*, Am.Soc.C.E., Vol. 22), and his "Tables Showing the Loss of Head Due to Friction of Water in Pipes," originally printed in reports of the city engineer of Providence and later published (1896) by Van Nostrand; and his "Report of the Results Obtained With Experimental Filters at the Pettaconset Pumping Station of the Providence Waterworks" (seventeenth annual report of the Rhode Island board of health, 1893). After 1897 Mr. Weston was president of the Jewell Export Filter Co., which built many mechanical filter plants in foreign countries.

Frederic Pike Stearns **1851-1919** Mr. Stearns entered the office of the city surveyor of Boston in 1868. From 1872 to 1880 he worked under Alphonse Fteley on the Sudbury River water-supply works for Boston and collaborated with him in the hydraulic experiments

Frederic Pike Stearns
Chief engineer Massachusetts board of health, 1886-95, and of Metropolitan Water Board, 1895-1907.

already mentioned. He also prepared a paper "On the Current Meter, Together With a Reason Why the Maximum Velocity of Water Flowing in Open Channels Is Below the Surface" (*Trans.*, Am.Soc.C.E., Vol. 12). From 1880 to 1886 he was engaged principally on the Boston main drainage work. In 1886 he became chief engineer of the Massachusetts state board of health. Later he became chief engineer of the Metropolitan Water Board, a position which he held until 1907.

John Ripley Freeman **1855-** Mr. Freeman is the only living engineer whose work is noted in this paper. Graduated from the Massachusetts Institute of Technology in 1876, Mr. Freeman was assistant engineer to the waterpower company at Lawrence, Mass., and to Hiram F. Mills, 1878-86, and since then has had a wide and varied experience in fire hydraulic and waterworks engineering. His papers, "Experiments Relating to the Hydraulics of Fire Streams" (*Trans.*, Am.Soc.C.E., Vol. 21); "The Nozzle as an Accurate Water Meter" (*Trans.*, Am.Soc.C.E., Vol. 24) and "The Arrangements of Hydrants and Water Pipes for the Protection of a City Against Fire" (*Jour.*, N.E.W.W Assn., Vol. 7), should be mentioned prominently in any list of hydraulic and water-supply classics of the nineteenth century. Mr. Freeman's forceful personality and his achievements in many fields other than hydraulics are too well known to require further mention herein.

New Electric Pumping Plant to Supplant Steam Station in Pittsburgh

Modernization necessitated by condition of old pumping facilities—Analysis of four proposed plans leads to adoption of electric equipment

By ROSS M. RIEGEL
Department Designing Engineer, Department of Public Works, Pittsburgh, Pa.

A STRIKING ILLUSTRATION of a prevalent tendency in municipal waterworks to resort to electrical pumping is seen in the new Brilliant pumping station of the Pittsburgh waterworks now under construction. The equipment in the old station required replacement, and a study was made of four plans of modernization. As a result it was decided to build an entire new pumping plant using motor-driven pumps with a total capacity of 170,000,000 gal. daily (170 m.g.d.). Although two of the plans featuring steam-driven pumps gave lower annual costs, other considerations led to the adoption of the electric-pump plan.

The steam station to be replaced was built about 1875 on the Allegheny River 7 miles above its mouth. At that time it pumped raw Allegheny River water to reservoirs in Highland Park, which supplied the easterly section of Pittsburgh. About 1900 the station was re-equipped so as to be accommodated to new reservoir construction. In 1906–07 the city constructed a new filter plant on the opposite side of the river at Aspinwall, connected to Brilliant station by a double steel pipe under the river. The old river inlets were closed and the station then pumped filtered water to the same district as before, but the pumping equipment was not materially changed.

This station has rapidly been approaching its limit of usefulness. The pumping engines, of the vertical-compound displacement type, are reaching an average age of 30 years, and, while originally they were rugged and satisfactory machines, breakages are becoming increasingly frequent and repairs expensive. The boiler plant is also becoming obsolete; the furnaces and stokers are not only out of date but never had been very good. The building itself, while secure as to foundations, needs extensive repairs to its superstructure to keep it in satisfactory condition as to appearance and resistance to the weather; and furthermore, the pipe and valve system controlling the discharge of water from the station to the reservoir rising mains is in very unsatisfactory condition. Pipes and valves had been installed during a period of 50 years to meet the circumstances of system changes as they arose, and the resulting situation has become unsatisfactory as to operating risks and as to the ability to make repairs. All these conditions necessitated the radical reconstruction of the pumping facilities.

Service Requirements

The present duty of the station is to pump water from the filtered water reservoir at the filter plant to two reservoirs in Highland Park, designated as No. 1 and No. 2, the static head at No. 1 being 326 ft. and at No. 2 236 ft. Reservoir No. 1 distributes water chiefly to the east-end district, although about 25 per cent of its delivery is repumped to even higher levels at the Herron Hill station. Water from No. 2 reservoir supplies the downtown business district and the lower levels on the south side of the Monongahela River. Through booster-station service it also supplies higher levels on the south side. The No. 2 service is approximately paralleled as to pressure by the main distribution service on the north side, or the old city of Allegheny, which is cross-connected so that a certain degree of interchange of supply is available between the north side and the service of No. 2 reservoir. Water can also be bypassed from the No. 1 high level system to No. 2 in case of emergency, so that the No. 2 system has a reserve of reservoir capacity that is not possessed by the No. 1 system.

From the records of the existing station it is found that the mean annual pumpage of No. 1 is 42 m.g.d., with a maximum day in 1929 of 55 m.g.d. Similarly for Highland No. 2 service the average and maximum figures are 32 and 49 m.g.d. respectively. Study of the trend of pumpage for the past five years (Fig. 1) shows a yearly increase in the No. 1 pumpage of about 1.2 m.g.d., while the trend of No. 2 pumpage is horizontal. These changes are affected by many considerations. The demand on No. 2 service apparently is constant in spite of growth in territory because of the removal of certain

COMPARISON OF ANNUAL COSTS

(Col. 1, costs immediately after installation. Col. 2, estimated costs for ten-year operation.)

Annual Cost	Present Installation	A L.P. Steam, New Bldg. After 10 Yrs.		B H.P. Steam, Pres. Bldg.		C H.P. Steam, New Bldg.		D New Electric	
Investment—New	.....	$540,000 (1)	$540,000 (2)	$750,000 (1)	$1,500,000 (2)	$1,730,000 (1)	$1,730,000 (2)	$900,000 (1)	$900,000 (2)
Operating costs:									
Fuel or power	121,498	96,940	96,940	91,750	73,700	68,000	73,700	224,717	228,000
Labor	101,971	90,000	105,000	90,000	63,800	54,700	63,800	22,613	26,385
Maintenance	52,905	45,000	45,000	45,000	32,000	32,000	32,000	13,000	13,000
Supplies	10,118	10,000	10,000	8,000	5,000	5,000	5,000	3,000	3,000
Heating	.....	.....	.....	.....	.....	.....	.....	550	550
Cold storage	.....	4,000	4,000	4,000	4,000	4,000	4,000	.....	.....
Total	$286,492	$245,940	$260,940	$238,570	$178,500	$163,700	$178,500	$263,082	$270,935
Fixed charges, new money	.....	88,000	88,000	48,750	110,250	106,190	106,190	49,200	49,200
External and extraordinary maintenance	.....	10,000	10,000	10,000	10,000	.....	.....	.....	.....
Total annual cost	.....	$343,940	$358,400	$297,320	$298,750	$269,890	$284,690	$312,282	$320,135

manufacturing plants to suburban areas. The pumpage to No. 1 reservoir is to a region in which the most pronounced expansion in residential construction has been occurring in the past few years, a growth that will probably continue. On the other hand, an earnest effort is being made to increase the proportion of meters on consumers' service lines (less than 50 per cent of the total services are on meters), and efforts to reduce waste and leakage in the distribution system are being made. During the past two years these efforts have produced results and it is likely that the average pumpage can be reduced or at least the hitherto observed trend of increase

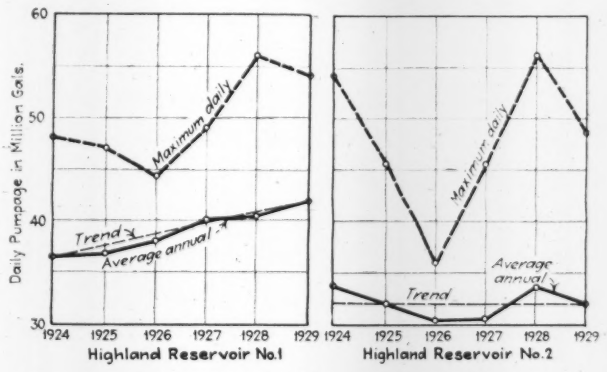


Fig. 1—Pumpage records of the existing Brilliant station show an increasing demand by Highland No. 1 district but a constant demand for Highland No. 2

Manufacturing plants have been moving from the No. 2 district for some years, while No. 1 district is a rapidly growing residential region.

can be materially diminished. The capacities assumed for the pumping units are determined upon the background of these facts and tendencies.

A Financial Problem

The financial circumstances in the bureau of water have a very important bearing upon the solution of the pumping-station problem. As in many other cities, the water revenue is collected by the city treasurer and goes into the general city income fund along with the city taxes; in fact, this revenue is treated as a tax and not as a service charge. Operating expenses of the bureau are paid out of the general budget appropriation of the city. Bond issues for financing major waterworks improvements and replacements can be obtained only by vote of the people at bond-issue elections, which are held only at intervals of four to six years.

Under this system the situation confronting the city authorities last year (1930) was as follows: Residual funds on hand from a bond issue amounted to about $750,000, of which about $500,000 had been scheduled as an original authorization for repair work on the steam station. Other funds could not be obtained in any volume except by a people's bond issue, which the city authorities did not deem opportune at that time. Any material expense over the $750,000 available would involve awaiting a suitable opportunity to obtain additional funds, which would involve considerable expense at that time to insure continuance of reasonably safe operation.

Four Plans of Action Studied

Four methods of meeting the situation were thoroughly studied, and station layouts and general designs were worked out in sufficient detail to insure fairly accurate estimates. These included the following:

A. Resetting of old boilers and provision of two new 25-m.g.d. turbine-driven pumps; a new station to be built after ten years.

B. Installation of new high-pressure equipment in the old building, as described in *C* to be done in two installments, the second after proper financing.

C. Construction of a complete new steam station to contain six 25-m.g.d. turbine-driven centrifugal pumps operated at 325 lb. steam pressure and 200 deg. superheat.

D. Construction of a complete new electrical station on ground adjacent to the present station, with proper connections for suction and discharge to the existing supplies and a present installation of six motor-driven pumping units of 25-m.g.d. capacity.

Estimated costs of construction and operation of these four plans are given in the accompanying table, and for the purpose of comparison the current operating expenses of the present station are included. The columns marked (1) and (2) show respectively the estimated costs immediately after installation and the estimated average costs for ten years of operation, taking account of trends of labor costs, volume of pumpage and power rates.

The features of the several schemes are stated more fully as follows:

A. It was contemplated in this plan to use the present station for about ten years, utilizing the residual life of the present equipment to the fullest possible extent. Two new 25 m.g.d. turbine-driven pumping units would be installed to perform the normal pumpage to High-

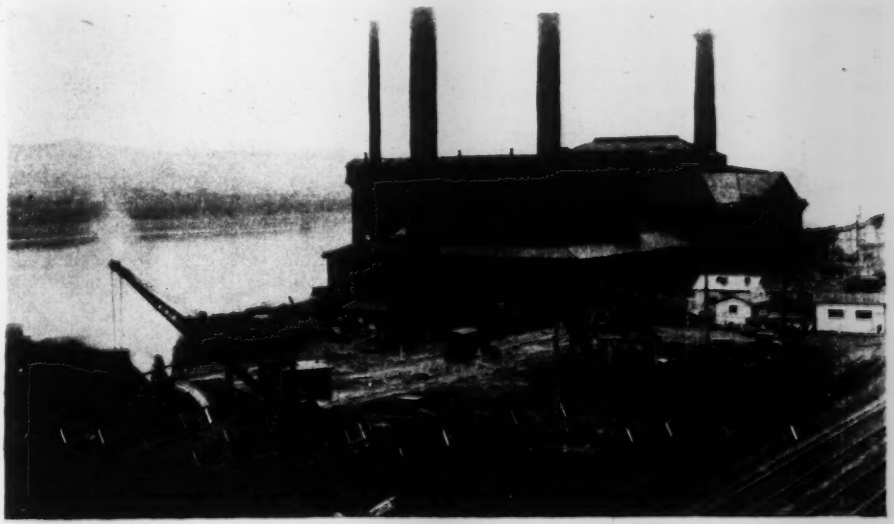


Fig. 2—The new electric station is being built on the site in the foreground, directly adjacent to the old steam plant

land No. 1 reservoir, and four existing 15-m.g.d. pumps, only 24 years old, would be used for Highland No. 2. The four best of the existing boilers, rated at 500 hp., would be reset with underfeed stokers, furnished with induced-draft fans and could be operated at 185 lb. pressure and 100 deg. superheat. The plan was estimated to cost $540,000, nearly all of which would have to be written off in ten years, at which time the construction of a new station could be no longer postponed. Pipeline risks would be continued in the meantime. It was distinctly a makeshift.

B. This plan contemplated the use of the present building, with a complete new installation of pumps and boilers, operating at 325 lb. and 200 deg. superheat. Four 750-hp. boilers and six 25-m.g.d. pumping units

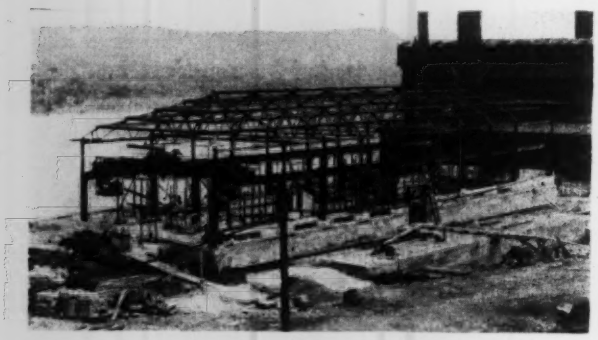


Fig. 3—The new Brilliant station will be faced with Indiana limestone. There is to be an underground vault for valves immediately in front of the building. The transformer yard will be at the rear, facing the river

would be required. The plan proposed to install two boilers and two pumps at once, the rest to be installed as soon as the necessary funds could be obtained. This plan is superior to scheme *A* in economy, both immediate and ultimate. The disadvantages are those accruing from the use of the old building and the pipe lines previously referred to. To evaluate costs likely to arise from the use of existing pipe lines, the item of $10,000 per year for extraordinary maintenance was set up as applying to schemes *A* and *B*, although this sum was felt to be entirely inadequate to measure the risk of continuing these operations. Coal was figured at $2.62 per ton, the average figure of the five years preceding the study.

C. Under this plan a complete new steam station with equipment as in scheme *B* was contemplated, to be built on land adjoining the present station (the latter then dismantled). Operating costs are the same as in scheme *B*, but the capital investment is greater. On the other hand, the risks from the pipe lines and valves are eliminated. This plan is regarded as satisfactory from the standpoint of safety.

D. Under this plan a new electrically driven station would be built adjoining the present station, having six motor-driven units with a total power capacity of 9,000 kw. Current would be bought from the Duquesne Light Co. at the low-tension side of the substation, which would be owned and maintained by the light company.

The item of external and extraordinary maintenance has been explained. In the estimates for steam stations an item for coal storage has been set up. This allowance for costs that have periodically arisen due to coal strikes in the region is justified by experience.

As to maintenance costs, those for steam stations are based on the records of the existing stations, with corrections for new conditions. Maintenance on the electric station should be low, particularly as the power company maintains the substation.

Scheme *D*, for the electric station, was adopted because:

1. A complete new station with maximum security could be obtained with the minimum capital expenditure and in minimum time.

2. Smoke nuisance would be eliminated (though a modern steam station should produce but little smoke).

3. Speed of construction, simplicity of operation and simplification of supervision were obtained.

4. Under the circumstances of municipal operation the probability of exceeding the estimated costs was regarded as greater in the case of the steam station than of the electrical station.

5. As to trends of costs, it was felt that coal must advance in price somewhat as time passes inasmuch as it is apparently now selling in this district at or near the cost of production. Any increase would be reflected in operating costs. The economy of the station could not be enhanced during the life of the equipment. On the other hand, the increasing efficiency of electrical production has been reflected for many years in a lowering power rate, and no reason appears why this tendency should not continue. Whereas current is bought for this station under a regularly published tariff (giving a rate of about 6.8 mills per kilowatt-hour), the city would profit at once by any further cut in rates. This tendency has been discounted to a certain extent in the estimates, but is believed to be probably undervalued. If the hoped-for pumping reductions should be realized, a greater proportional saving in total costs would be produced with the electric station.

6. This station is close to two other stations just across the river, now operated by steam, and all three are within a radius of a mile. Brilliant and Aspinwall stations could possibly be operated with electric current generated at the third station (Ross) if the purchase of current from the light company should prove unsatisfactory.

All these considerations were of weight in deciding to install the electric plant, even though its computed economy was not the greatest. In any event, present operating costs will be materially diminished. The conclusion illustrates the principle that judgment must sometimes go beyond the numerical result of the problem and be influenced by all the pertinent factors.

After the decision to electrify was made, further study of hydraulic factors and the power rate schedule led to the purchase of four 28-m.g.d. pumps for Highland No. 1 service, and two 24-m.g.d. pumps for No. 2 service; one of the former to be connected to both services and to be provided with interchangeable low-head impellers. This unit will be normally connected to No. 2 service, but the arrangement materially increases the effective spare capacity.

The station is now under construction; the substructure is under way; pumping units and electrical control have been purchased and the contracts for superstructure and outside piping will be let shortly. It is hoped to have the station ready to operate by the end of 1931.

The Brilliant station is being constructed under the administration of the department of public works of Pittsburgh, Edward G. Lang director, and Charles M. Reppert chief engineer. James H. Kennon, managing engineer of the bureau of water, is in administrative charge of the waterworks. The writer supervised the studies covered herein as assistant to Mr. Reppert.

Factors Governing Arrangement of Modern Pumping Stations

Site topography and accessibility, water levels, expansion provisions and good appearance should control design layouts

By CHARLES B. BURDICK
Alvord, Burdick & Howson, Engineers, Chicago, Ill.

A MODERN pumping station is not simply a rectangular box with a hip roof housing the simple equipment of a half century ago. Adjuncts such as filters, reservoirs, basins and clarifiers make the problem of its design one of intricacy and good judgment, since always in the background there must be an eye for future extensions. Mr. Burdick in his paper says that no two plants, even by the same engineer, show much similarity of layout because the local conditions to be satisfied are rarely alike. —EDITOR.

THE ART of public water supply has passed its infancy. At the present time it is possible to design with a view to permanency. This was not possible a few generations ago. During the great building period of the 1880's future service could only be roughly approximated, and the equipment required to meet it remained to be standardized. It developed only through trial and error. We are in a much more fortunate position today, although, no doubt, the art will continue to develop. It is now possible, however, to predict future requirements with reasonable accuracy and to build with reasonable assurance of permanency.

The design of waterworks pumping stations involves many problems of mechanical, electrical, civil engineering and architecture that it is not proposed to consider here. The following comments relate more particularly to the arrangement or layout of pumping stations. It is endeavored to state a few general principles applicable to all such designs and to illustrate their application in actual practice.

About two-thirds of the cost of water is represented by fixed charges upon the necessary investment to furnish it. If water is to be furnished at the least cost possible, it follows that the capital expenditures should not be out of proportion to the service to be rendered. The average city doubles in population once in 20 or 25 years. Water at the least cost, therefore, should properly involve a building program that can be indefinitely followed, building well in advance of need as circumstances may require. When a correct program has been laid down it is possible to build for the indefinite future with reasonable assurance that each dollar invested will be a permanent link in a program of improvement.

To build for permanence the following requirements are necessary for success: a reasonable knowledge of future requirements; correct selection of sources and site; a building program as definite as possible; a layout adapted to needs and local circumstances; a correct selection of equipment; a proper selection of building materials; and a due regard for appearance.

It is not the purpose here to discuss source of water supply further than to mention that it is fundamental to any permanent pumping project. The site for building a pumping station is necessarily largely governed by the source of supply and the way in which the supply is to be developed and pumped. The selection of the equipment for developing and pumping the water also has a fundamental relation to a station layout, although in so far as possible, permanence properly involves a provision

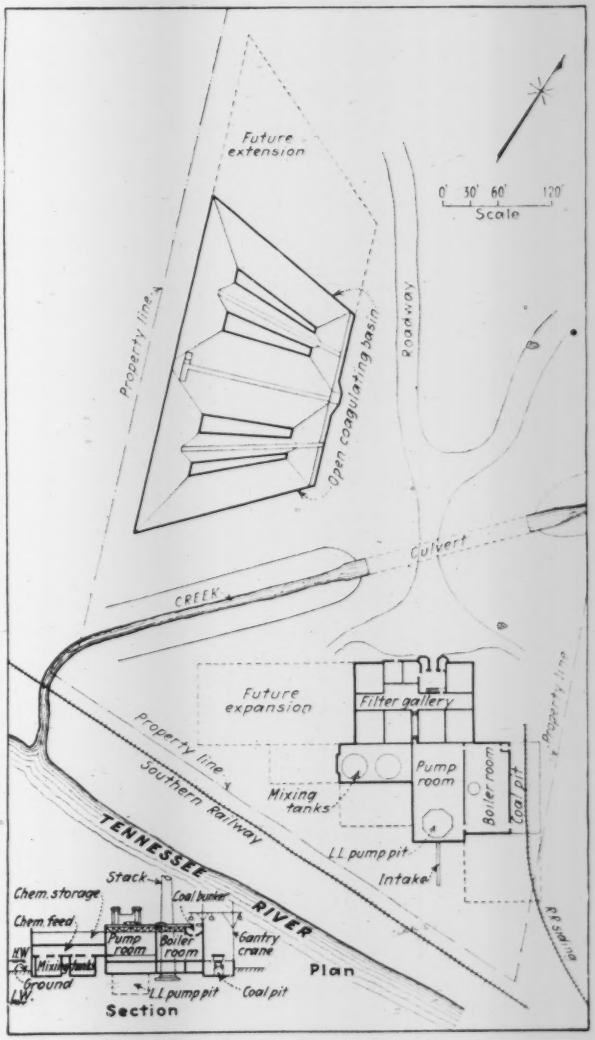


Fig. 1—Layout of Williams Creek water plant at Knoxville, Tenn.

It was necessary here to utilize an irregularly shaped site with rough topography. The Tennessee River has a large variation between high and low water.

for adequate elbow room everywhere so that future changes in the art may be utilized to best advantage without abandoning good permanent construction.

Conditions Vary for Each Plant

Local Factors—To one not accustomed to the design of plants it may be a source of wonder why no two plants seem to be laid out the same way. It is not explained on the ground of personal equation. Different plants by the same designer bear little resemblence, especially if the designer is capable and has taken full advantage of the local circumstances. Certain characteristics may be similar, but they are generally inconsequential.

Among the local circumstances that most impress themselves upon the design are the nature of the water supply, how it is to be pumped and the topography of the site. Most pumping stations, regardless of the source of supply, are located upon low ground, usually upon the banks of streams. Practicable construction usually involves the relation between high and low water. Often this consideration is fundamental, as illustrated by the plants on the Ohio River, or where the difference between high and low water amounts to as much as 60 ft. Such stations involve special and expensive construction in order that pumps may be set within suction reach at low water. Also premises should be free from

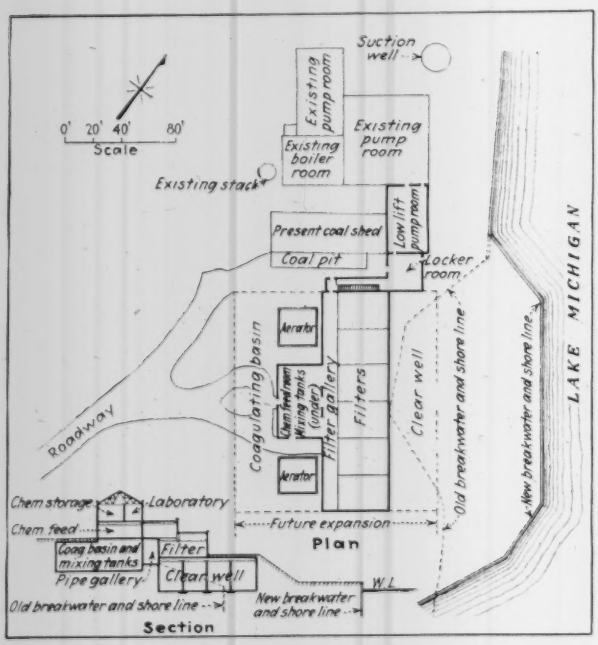


Fig. 2—Sheboygan, Wis., filter plant was built partly on the beach and partly on the adjoining bluff

A narrow site was provided, and it was necessary to coordinate the new work with the existing pumping station.

extreme floods. Layouts are much simplified upon the Great Lakes and adjacent to many streams with relatively small variations in water stage.

Another important consideration is the question of access to the property as regards highways. If the pumping plant is steam-operated, the utilization of practicable railroad facilities is essential. The writer recalls one or two instances where the general plant layout was largely dictated by the facilities for handling coal and the practicable curvature and alignment of the railway sidings. For the convenience of employees and the general public it is obvious that the entrance to the plant should be easily discovered by one approaching the plant and reasonably convenient of access from the highway of approach.

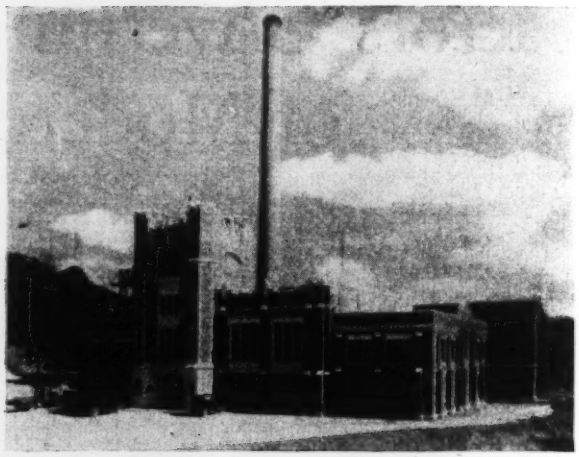


Fig. 3—The Knoxville plant superstructure

It often happens that structures below the ground have an important influence on the layout. The passage of the water should be as direct as possible from the source to the pipe distribution system. Where large pipes and conduits are involved, entailing important expenditures, they must be given proper consideration, reducing distance as much as possible and avoiding unnecessary curvature or undue complications. Such underground structures as reservoirs, particularly if the water must be purified, very largely affect the layout and the practicable elevations of various parts of the plant.

The above circumstances usually dictate the practicable floor levels. Thus, assuming that the water is filtered, the low-lift pumps must be accommodated within suction reach of the supply, often in a pumping pit, which should be in or immediately adjacent to the main pumproom. In the general layout the floor of the clear-water reservoir must be as low as possible, usually coincident or a little below the low water plane of the adjacent stream. The practicable depth of the clear-water reservoir, usually 15 to 20 ft., plus the height of the filters, generally about 10 ft., fixes approximately the water flowline in the mixing and coagulating basins. It is a good site if the plant can be thus accommodated, affording good foundations without excessive excavation and permitting of surrounding grounds at a convenient elevation after the cuts and fills have been balanced, all with due regard to excessive flood stages in the stream.

The floor of the high-lift pumproom may be set at any convenient elevation accessible to the water in the clear-water reservoir. With present mechanical facilities for handling coal and ashes, the boiler-room floor can usually be fixed at a convenient elevation for intercommunication in the plant, provided it is protected from high water.

As regards other features of the plant, facilities for chemical storage will necessarily be upon a second story at least 10 ft. above the filter tops, so as to permit of gravity feed. Office, laboratory, lavatory and locker-room facilities may be at any elevation and location reasonably convenient to the main entrance of the plant.

Good Appearance a Stabilizing Factor—Although this feature of the design is often neglected, good architecture is proved to be reasonably required for permanency. No one likes to destroy a beautiful structure, and there is

no need to do so if it continues to be adapted to its purpose, as it will be if it is well designed, and with a reasonably correct conception of the future service to be performed. Everyone welcomes the oportunity to get rid of an eyesore. The tendency to perpetuate a beautiful object, even though of no practical use, is well illustrated by the old Chicago water tower that now partly blocks Michigan Ave. Another instance is recalled where an old pumping station is still maintained, although useless for years, because of its beauty and sentiment.

The average investment in public water supply at this time is not far from $50 to $60 per capita. From 80 or 90 per cent of this investment is buried in the ground where no one can see it. It is very necessary to a successful public water supply that the people should be interested in it. If it is well managed, it is in the interest of everyone that the public should have a high regard for it. This regard is very largely fostered by the excellence and the good appearance of that part of the plant that the people can see. The importance of this phase of design is well exemplified in a few cities that have built with due regard to attractive architecture in their waterworks structures, set in attractive and well-maintained surroundings.

The type of architecture should be adapted to the surroundings of the waterworks property. In a permanent structure it is worth while to be conservative, avoiding the extremes of architectural fashion. The visible structures should be substantial, graceful, relatively simple, presenting the appearance of the masculine rather than the feminine. They may even approach elegance if the setting is suited to it. They should be properly in keeping with their surroundings. It is now practicable to design an electrically driven pumping station that should be no detriment to a public park or a high-class residential district. With the possibilities for landscaping, a waterworks pumping station can be made an attractive addition to a public park and has been so utilized in a number of instances. Even the covered reservoirs are admirably adapted to beautification and public use.

Materials—Reservoirs, filters and foundations are now quite generally built of reinforced concrete. This material, however, is ill adapted to exposure to the climate in our northern latitudes, particularly when such structures contain water. They should be banked about and covered over with earth. When so built they are practically indestructible. Superstructures should be built of more enduring masonry such as brick or stone. They must necessarily be fireproof, and it is now practicable to build them using nothing that will burn.

Interior Finish an Important Factor

A word should be said regarding interior finish. Generally speaking it should be planned with the same regard to appearance previously spoken of. In addition it should be of materials easily kept clean and having the appearance of cleanliness. In this respect, a waterworks station is similar to a modern hospital, and cleanliness is almost as important. Ceramic materials should be used liberally for floors and for walls at least head high. While colors may suit the taste, the lighter colors are preferable. Tile and terrazzo make the best floor materials. Experience has shown that, with good materials, cleanliness on the part of the operators becomes a matter of habit. Several waterworks boiler rooms come to mind that are just as attractive, light and clean as any room anywhere. This is true even of that portion of the room in the rear of the boilers. Several good operators are firmly convinced that such surroundings have an important effect on all the work done by the employees.

Fixed Administration Center—In any pumping plant, however simple the design, there should be an administration center at the entrance to the plant, so located that it can remain practically unchanged with material enlargements to the plant. In a very small station this may be no more than an attractive entrance, a desk for an attendant and perhaps lavatory facilities. In a larger plant it may properly include one or more offices, a laboratory, lavatory and locker room for employees of the water department.

From the central structure the various parts of the plant should be readily accessible and each special facility should be so arranged that future expansion is possible in an orderly way. If skill is exercised, this can often be done without detrimentally affecting the architecture of the building. In all events it is a necessary requirement for permanent construction in a growing community.

In some instances very large plants have been built using separate buildings for various purposes throughout the waterworks grounds. It is believed that this should be avoided whenever possible, even in cases where a

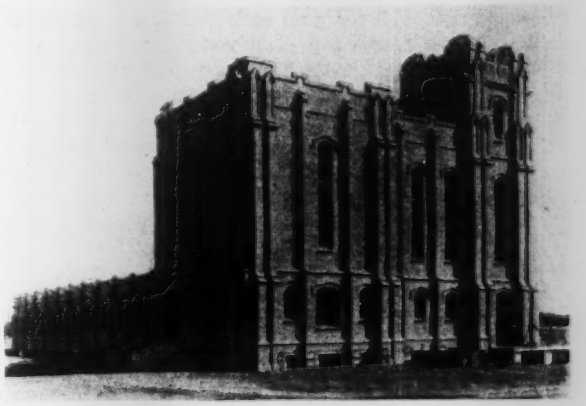


Fig. 4—Special brick, matching the color of Bedford stone, was used on the plant at Cedar Rapids, Iowa

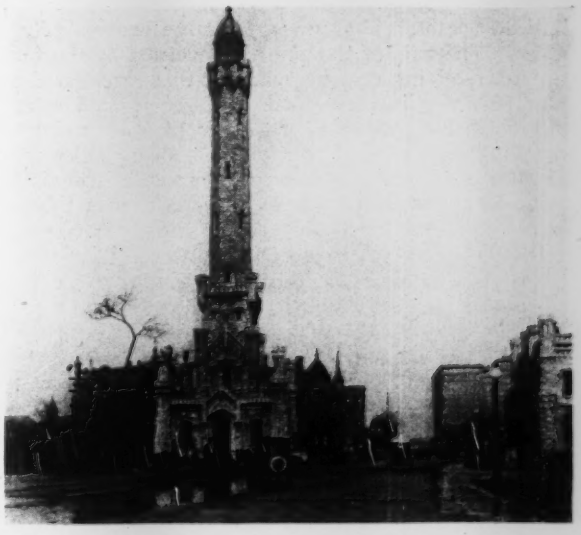


Fig. 5—The old Chicago water tower remains as a landmark

Although it has not been in use for years, public sentiment prevents its destruction.

plant involves both pumping and water-purification facilities. A waterworks plant is manned by a comparatively small force. A very large filter room is commonly operated by one man per shift, and in plants of considerable size one man per shift attends to all the operations, including the chemical feed. Electrically driven pumping stations involve one attentant per shift, except where more are required for humanitarian reasons. A waterworks is believed to be more effectively and better operated if all of its operations center at one place. If this is done, a comparatively small number of men can be effectively supervised practically under the eye of the chief engineer. With a good site and with its most effective utilization it is usually practicable to lay out a plant so that it permits the expansion of each facility in an orderly way as the service grows.

The accompanying sketches illustrate the way in which local circumstances affect a plant layout. At Sheboygan, Wis. (Fig. 2), the layout of a 12-m.g.d. plant is governed by the shape of the available waterworks land and by an old adjacent steam pumping plant on the shore of Lake Michigan. The ground rises abruptly from the narrow sand beach to a height of some 20 or 30 ft. The site is comparatively narrow where the new plant adjoins the old plant. A close connection is desirable, particularly in view of the small force on each shift. The most practicable scheme dictated a clear-water reservoir on the beach, partly on made land protected by a breakwater, with coagulating basins practically all in excavation, located on high ground, with filters resting upon the roof of the clear-water reservoir and with laboratory and chemical storage in a second story over the main entrance. Access to the entire plant in this case is through the operating floor of the filter plant, thence through the low-lift pumping room and into the old steam pumping plant, which, on account of its low elevation, is largely concealed by the new construction. This plant can be indefinitely extended parallel to the lake shore by repeating filter units, clear-water reservoir and coagulating basin bays, corresponding in width to the filter installation.

At Knoxville, Tenn., the situation is entirely different. The plant is located on the banks of the Tennessee River with a comparatively high flood elevation, and the site is somewhat restricted by a creek with steep banks cutting diagonally across the grounds, too large economically to inclose. The axis of the plant is governed by the facilities for receiving coal by rail. In this case the clear-water reservoir is very small, a large elevated storage reservoir being available. In order to leave room for expanding each part of the pumping plant, boiler room and filter plant it was necessary to locate the coagulating basins on the opposite side of the creek. On this site open basins were practicable, as the climate is comparatively mild.

At Des Moines, Iowa, there is a groundwater plant. All water is pumped without storage directly into the distribution system. All pumps are necessarily set slightly above the low-water plane in the adjacent river, with all door sills located 20 ft. higher on account of high water. The surrounding ground is well below the extreme flood-line; and as floor levels were necessarily above high water, the most feasible plan for the improvement of the grounds consisted in building up the roadways only and utilizing the borrowpits as lagoons. Under the direction of a competent landscape architect this solution of the problem has produced a very beautiful effect at an expenditure considerably less, including all planting, than would have been involved to bring the ground up to a dead level above the high-water plane.

Thus it will be seen that each new site and set of circumstances presents its own problems, which, if correctly solved, should assure for each pumping project a long life, continued usefulness and greatest possible economy in service to the water consumers.

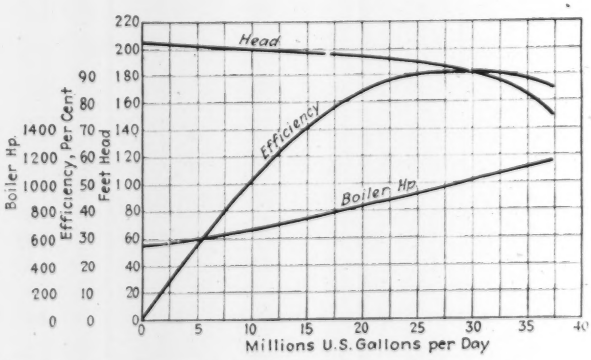
Great Economies Achieved by Modern Pumping Equipment

Centrifugal pump efficiencies steadily advance —Improvements in steam turbines and electric power generation result in further economies

By W. M. WHITE
Chief Engineer, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

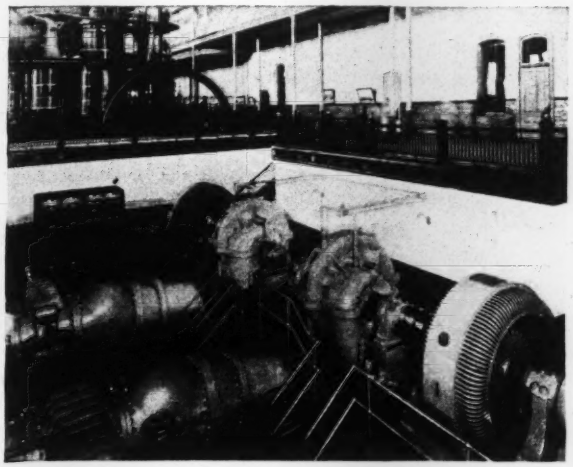
THE INVENTION of the steam engine is closely associated with the pumping of water. The greatest ingenuity of our age has been directed to the perfection of machinery for that purpose, and each decade of recent times has seen the prize of highest duty go to some form of engine for the pumping of water. The height of the buildings of some of our manufacturing institutions was determined by the triple-expansion vertical direct-acting plunger pumping engine. This type of pumping equipment reached its perfection about twenty years ago and has held the admiration of its designers in the engineering profession and the devotion of its operators to this day.

The past twenty years have seen a change brought about by the changing economic conditions of our times. The invention and perfection of the steam turbine and the development of the centrifugal pump have provided a more economical means for the pumping of water when cost of original installation and cost of operation are truly balanced. The impulse steam turbine found favor in the early installations because of its economy in small sizes. As the demand for larger and larger units has increased, the reaction turbine of the Parsons type has encroached upon the impulse turbine because of its greater economy when constructed in large sizes. The development of cheap hydro-electric power, the



High efficiency within large range obtained by modern centrifugals

A typical set of performance curves shows an efficiency of 85 per cent or more at deliveries of from 70 to 125 per cent of rated capacity.



Motor-driven pumps replace pumping engines in Detroit

The two centrifugal pumps in the foreground have capacities of 50 and 70 m.g.d., respectively. The pit in which they are installed was previously occupied by a walking-beam pumping engine similar to the one seen at the rear. The old engine shown had a capacity of 30 m.g.d. It was removed in 1928, and in the space it occupied were installed two motor-driven pumps of 40-m.g.d. capacity each.

spread of the network of interconnected power lines; the improvements in the economy of large steam-turbine generating units and the further perfection of design and increased efficiency of centrifugal pumps have brought new agencies with which those engaged in supplying cities with water at an economical rate have necessarily to deal.

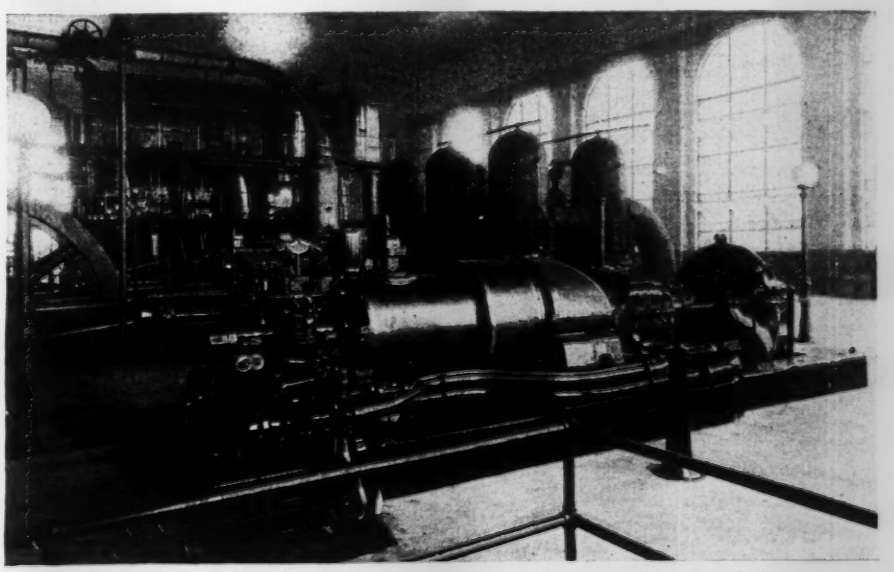
We are certain to see a greater number of reaction steam-turbine-driven units as the size of pumps increases, and even a much greater increase in the application of motor-driven centrifugal pumping units. The far-seeing waterworks executive should take cognizance of all these new agencies and so fashion new plants as to make greatest economical use of the new forces provided. There is probably no industry in which competition is keener than that in machinery supplied for city waterworks pumping. One reason is the public opening of bids and, in most cases, the award of the contract to the bidder furnishing most for the least money. The unquestioned credit of the city is another factor in interesting bidders in the work.

The fascinating problem of the design of centrifugal pumps entices to it the interest of all engineers, and such combined application is certain to bring increased efficiencies. As a result, the ratio of increased efficiency in respect to size is greater in the case of centrifugal pumps than that of vertical triple-expansion pumping engines. It is believed that greater station economy will result from the adoption of different sizes of pumps, so that a single unit may supply the normal demand for water, and units of different size, in combination, may supply the lesser or greater amounts of water required for abnormal operation. Remarkable economies are now secured by the leading pump builders in both steam-turbine and motor-driven pumps, and the requirement of efficiency is stressed in city specifications. The performances of leading manufacturers are not widely different. A curve is appended showing a typical efficiency of a large centrifugal pump. This is certainly not the maximum that will some day be reached.

Increased efficiency has been secured in centrifugal pumps by decreasing the wetted perimeter of the impeller by reducing its diameter. This has necessarily meant an increase of speed. Such reduction in diameter has meant reduction in the diameter of the suction passages of the impeller in order that a sufficient ratio may be obtained between the suction diameter and discharge diameter within which to fashion the vanes of the runner for economy and efficiency.

It would seem advisable to apply these same stringent requirements as to avoidance of losses to the suction and discharge piping of the station, so that the greatest economy from the surface of the water in the suction well to the delivery mains may be effected. An examination of the plans of many stations shows such a mass of elbows, crosses, valves and interconnecting pipes as to lead one to question whether attention has been directed to arranging and locating the pipes and fixing their sizes so as to effect the same economy in respect to efficiency and price for these parts as is required of the pumping unit itself.

One cannot produce velocity without force, or in our case, head of water; and as we are limited on the suction side to the suction lift of 34 ft., it follows that as the economy in pumps is increased it will have to be set lower with reference to the level of the water in the suction well in order to avoid cavitation and pitting at the intake edges of the runner vanes. Due consideration to maintaining some substantial pressure in the eye of the pump impeller by placing it sufficiently low will amply repay by the prevention of pitting and noise.



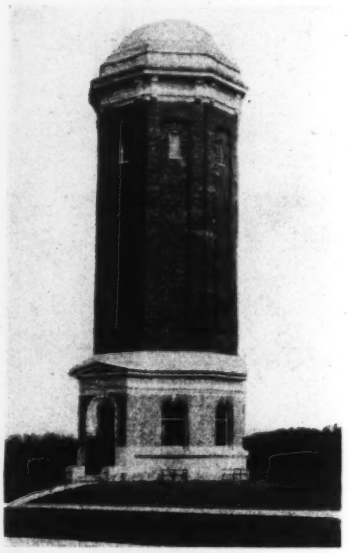
Up-to-date pumping equipment conserves space

The steam-turbine-driven centrifugal pump in the foreground has a capacity of 15 m.g.d. against a head of 183 ft. The vertical triple-expansion pumping engine in the background has a capacity of 12 m.g.d., and the horizontal pumping engine between the other two, 15 m.g.d. The installation shown is at Grand Rapids, Mich.

Waterworks Architecture

An Important Modern Consideration

By VICTOR A. MATTESON
Architect, Chicago, Ill.



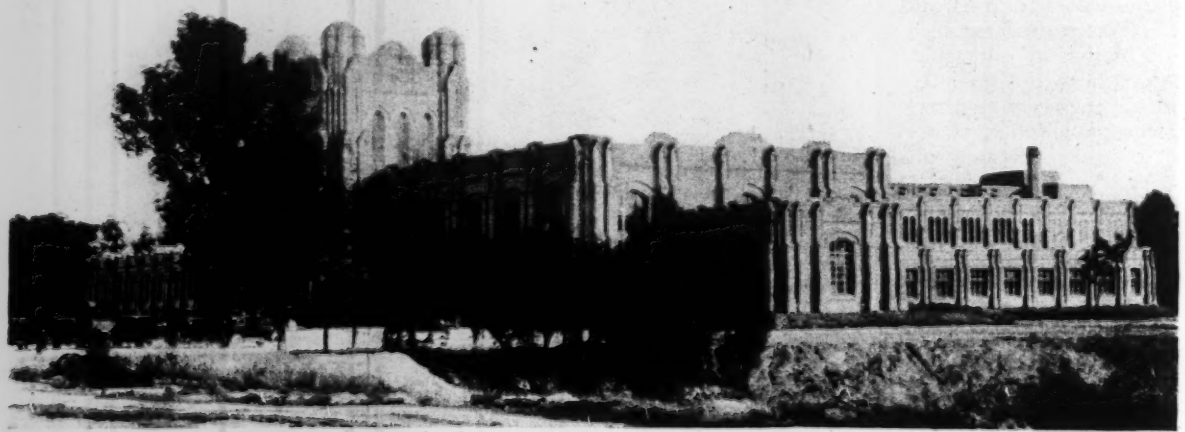
A masonry structure incloses the 200,000-gal. tank at Manistique, Mich.

IN TIMES PAST the importance of the waterworks has not been recognized in the development of municipal architecture. While its importance is well known among engineers, the public in general has given it little thought because in its physical character there has been too little evidence of an importance such as would indicate that without it the very existence of the community would cease. Surely a utility of such prime importance should in the course of city growth take its proportionate position in architectural development. As villages grew into cities it was typical that the village lock-up developed into an imposing jail, the sheriff's house into a court house, the book department of the grocery store into a library, and the house of the village president into a city hall.

However, the town pump remained pretty nearly only a town pump. When the hand pump was graduated into the steam class it was found expedient to put a roof over it, and walls were necessary to hold the roof. This inclosure, built at the least possible cost, was generally located in the back yard of the community, and its design, such as it was, was a distinctly back yard type. The drawings were quite often furnished by the manufacturer of the pump. Pumps and price being equal, the contract was probably awarded to that manufacturer who furnished, according to the artistic perceptions of those in charge, the least unattractive design. This developed a sort of competition which perhaps may be considered as having given the original impetus to the idea of better looking waterworks buildings.

In time the waterworks problem became something more than the mere purchase of a pump with a housing to protect it. There were many conditions to be considered, including engineering problems, some of which were not directly related to the pumps, economic considerations to be analyzed, and other matters that required the services of persons of scientific knowledge, practical experience and disinterested judgment. This brought the consulting engineer into the consideration. The waterworks as an engineering problem resulted, to be solved with as much scientific knowledge as the times afforded. However, while the engineering was greatly improved, the inclosures designed by those skilled in mechanical engineering still lacked architectural merit. No one seemed to mind, for it was only a waterworks. Appreciation of its importance was not given expression. Probably the engineers themselves were largely to blame; they were too busy with the work they were doing to tell the world of its importance.

More recently, amid the mad rush of money making and pleasure seeking, people seem to have stopped long



The washwater tank at the Saginaw, Mich., filter plant is housed by the central tower of the building group

enough to take more interest in the value of beauty and to realize that there are things in life worth while that are not strictly utilitarian. It is true that it matters little where they be located, whether at work, at home or at play, human beings are made happier and better citizens when influenced by attractive surroundings.

While formerly relegated to the back yard, it is now customary, or at least is becoming more so, to place the waterworks in a public park or in one of the better sections of the city where it may be made a part of the landscape. The extra cost of such a location, both as to land and extra piping, is compensated for by the added value given to neighboring property by the presence of beautiful buildings and attractive grounds.

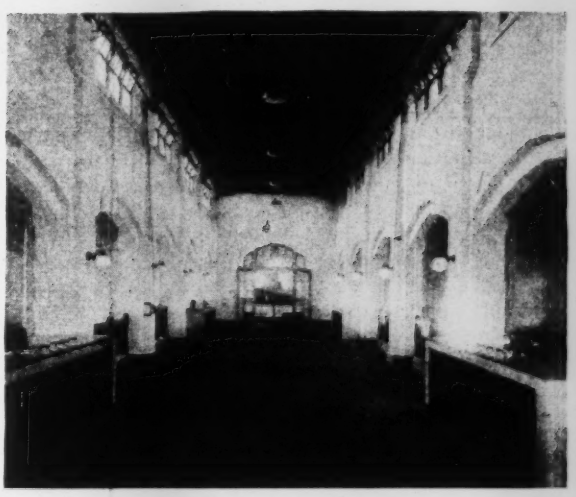
One of the supposed difficulties often cited as objections to making a waterworks architecturally well designed is the bugbear of extra cost. Actually the difference in cost between two buildings of identical size and arrangement, one of the conventional factory type, the other with some pretentions to architectural merit, is comparatively very little. It need not add 10 per cent to the cost of the superstructure. When expressed in terms of percentage of total cost of the entire project, including underground piping and equipment, the added cost is frequently less than 1 per cent. It is now being more and more realized that expenditure of a large amount of money underground with little to show for it above ground does not create good will and public interest and that it is good policy to give people something that they can see.

Pleasing architecture in Bloomington, Ill., plant

Many of the principles underlying good architectural design are the same as those governing good engineering design. Architecture may be briefly defined as the art and science of building. It involves first of all good planning, well-considered balance of masses, a knowledge of the proper use of ornament and color, and appropriate use of materials, and finally that rather indefinite something that is called "good taste." Usually a really good engineering plan is also a good one architecturally. The question of course then resolves itself into what constitutes a good engineering plan, for there are many workable and economical engineering layouts that are not ideal from the engineer's point of view, and the chances are that they will not result in a pleasing building either.

Symmetry is always a safe principle to maintain, but balance of parts about an axis, even if the parts are not themselves symmetrical, serves equally well in most cases. The important thing is for the masses to balance, so that the planner is compelled to think in three dimensions and in arranging his plan to give consideration to the height of the parts, if the best results are to be secured. A fundamental principle is that "form follows function." If the functional scheme is well balanced, the form that results will usually be well balanced also, and the basis for a good design is at hand. The more intelligently the engineering scheme is thought out the more nearly it approaches architecture. It usually happens that much can be gained by the collaboration of the engineer with the architect at the beginning of the study of the problem, provided the architect and engineer are mutually considerate of each other's problems.

To be successful any design should be harmonious in its composition. Like music, architecture to be pleasing must not include discordant features, or it will cease to be music and become "jazz." This is the reason, to illustrate, why any building is spoiled in appearance by having attached to it, or in close relationship to it, a steel stack or steel water tank, or other structure whose material and design are not in harmony with the material and design of the building. An attempt has recently been made to interest designers in solving the problem of the artistic design of the steel water tank without sacrificing utility. A water tank can be designed in a simple straightforward manner with good proportions that will not be an eyesore in itself and by itself or surrounded by its own kind. It becomes an eyesore when seen in relation to surroundings with which it is by nature entirely incompatible. There is nothing wrong about it when considered alone any more than there is anything wrong with the C-natural note of the musical scale. However, if this pleasing C is sounded along with the B-natural note there is discord. Harmony of component parts and materials, color and masses, is another of the constituents of a pleasing building of any kind.



Red tile floor, whitewashed brick walls and stained cement tile ceiling combine harmoniously to give attractive appearance at Cedar Rapids, Iowa

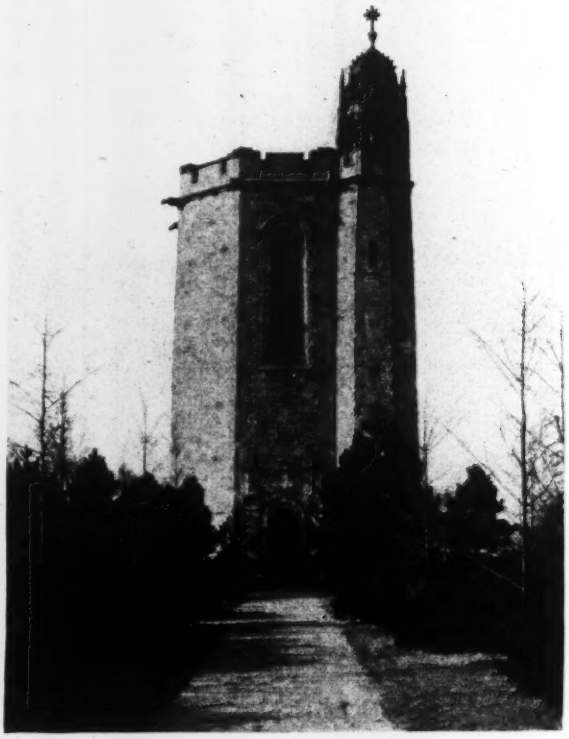
Reference has been made to the art of buildings as well as the science, as constituting architecture. The word "art" is used in a double sense. In one sense it refers to the "fine arts," in the other to craftsmanship. The proper use of moldings, carving, ornament and color involves a consideration of the fine arts, and is a subject too involved to enter into in this consideration. However, one use of color, masses and contrasts is of great value; that is the skillful handling of shrubbery, trees, flowers and grass in the immediate vicinity of the

building. The same principles of harmony in mass and color apply to designing the planting as apply to the building itself. If properly done any building can be rendered more attractive by the handling of the landscape in its immediate vicinity. Perhaps one of the best examples to be found anywhere in connection with waterworks is at Des Moines, Iowa, where, regardless of any merit or fault in the design of the buildings and in spite of the stack, the place is a beauty spot of which the citizens are justly proud and which attracts hundreds of sightseers daily.

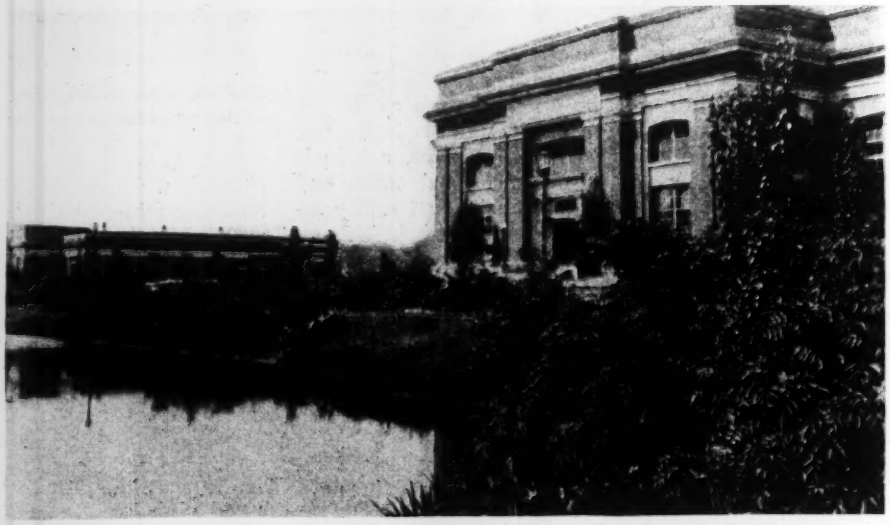
Reference has been made to the steel water tank, which is a difficult problem in connection with waterworks structures of architectural pretentions. Taken by itself, without attempting to associate it or to harmonize it with other units of different character and material, it may be so designed as to be not unattractive. I do not think that the attempts to do so have thus far been very successful. The easiest and probably the most satisfactory method of handling the steel tank problem is to cover the tank with building material in harmony with the building. There are other advantages, of course, in this procedure, because of the protection the covering affords.

Examples of this solution are common in commercial buildings. The writer used this plan in connection with the design of the waterworks building at Cedar Rapids, Iowa, where not only the washwater tank but steel chemical tanks are also inclosed. In the Saginaw, Mich., waterworks the washwater tank is inclosed in the tower, which forms perhaps the most attractive feature of the design of the building group. This is to be true also of the Fort Wayne, Ind., waterworks, contracts for which will be let this fall. At Glencoe, Ill., the washwater tank is of concrete buried in the ground at the top of the bluff. At Knoxville, Tenn., the washwater tank is of steel without legs, resting on a ledge excavated from the side of the bluff, largely hidden by the bluff on two sides and by a forest on the other sides. At the plant at Miami, Fla., the lime and chemical tanks were inclosed in the upper part of the treatment building, but the washwater tank was exposed, with disastrous results, artistically speaking. The water tower at Gary, Ind., is one of the earlier examples of an inclosed tank, and another is that at Manistique, Mich., where the base of the tower houses also the electric-driven pumps. A still earlier tower is the old Gothic structure which houses the standpipe, now out of service, at the Chicago Ave. pumping station, Chicago, which is preserved as a monument to the work of the early Chicago waterworks designers. This stone tower may be criticised architecturally, but it is nevertheless a beautiful tower and is worthy of preservation.

The stack is a feature which the electrification of the waterworks is eliminating in many cases. This is very fortunate, not because a stack is necessarily ugly, bu because it is customarily so. A steel stack is ugly an out of place when associated with a building for th same reason that a steel water tank is. A concrete stack may be made to harmonize with a concrete build ing, although it seldom does. A brick stack can be made to harmonize with a brick building, but seldom does because a plain radial brick stack cannot be made that is efficient and practical and cheap. For some reason



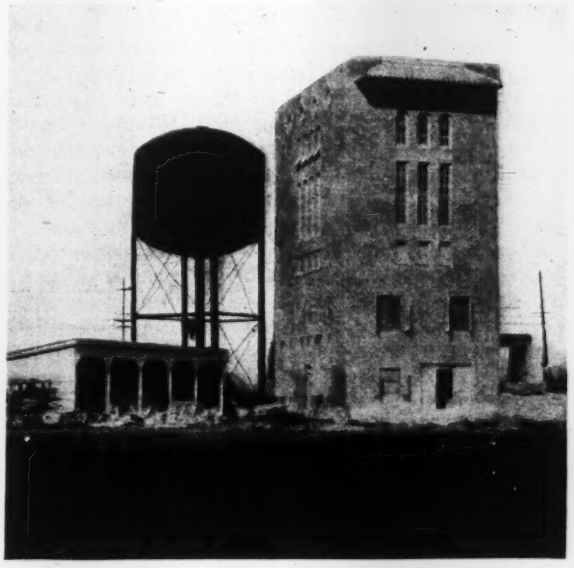
Masonry tower at the Gate-of-Heaven Cemetery, Hawthorne, N. Y., incloses a 70,000-gal. steel tank



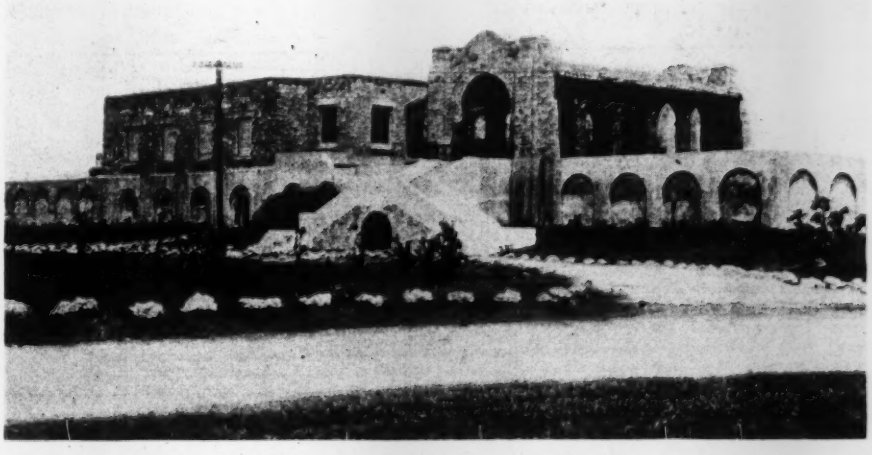
The landscaping at the Des Moines waterworks building creates a beauty spot. An old borrowpit was utilized to form the artificial lake

the incongruity of such a stack coupled with a relatively expensive and attractive building has not been perceived by those responsible. The stack should by all means harmonize with the building in design and materials, even if a sacrifice has to be made in the design of the building.

As there are many more people who see the exterior of a building than there are who enter it, it is natural that if there must be economy the sacrifice should be made on the interior. Simple and inexpensive materials may be used without objectionable results if the basic principles of harmony proportion are maintained. The control gallery at the Cedar Rapids waterworks, for example, has common brick walls, whitewashed, stained cement roof tile for ceiling, a special treatment of roof beams, a red tile floor and black wrought-iron railings. Massive arches separate the control gallery from the filter space. The effect is secured by harmony of color and carefully studied proportions, but with the use of the least expensive materials. A similar effect is secured in the control gallery of the Saginaw plant, where, however, much more expensive materials are used.



The proximity of the steel tank and the masonry building at Miami, Fla., creates a displeasing effect



Early American Spanish architecture of the Miami filter plant is in keeping with general Florida atmosphere

A waterworks structure is usually designed with a view to its continued use for a longer period of years than is the case with many commercial and speculative buildings. For that reason there is more need for selecting materials that will "wear well"—that is to say, look well—for a long time with the least cost for maintenance. Such materials are not necessarily the most expensive, but usually they are the better materials. Natural materials, such as stone, burnt clay and metal, which have stood the test of the elements and time are the most satisfactory. The interior of the building should look clean, and should be finished with materials that not only look clean but that will continue to do so for the longest period and with the least care. White is not a particularly satisfactory color, as when new it looks clean, when old it may be so but not appear to be. On the other hand there are colors that do not show the dirt and are objectionable for that very reason. As a rule the best materials are those that can be used as an integral part of the construction rather than those that are applied to the surface. However, discretion has to be exercised in the choice of such materials in order that they be not damaged during construction and that the finished result will be satisfactory without question.

The character of the design will vary largely with the views and temperament of the designer. However, there are some points which appear fundamental. The waterworks is a public building connected with a utility of prime importance, and it should reflect a dignity, repose and purpose befitting its use. A picturesque building, suited for use as a residence or a clubhouse, obviously would be out of place as a type of architecture suited to such a purpose. The classic styles are suitable but not sufficiently flexible in most cases for ready adaptation. Flexibility is essential, and this characteristic is found in Gothic and most medieval styles, coupled with the desirable feature of dignity. In the Southern states the local adaptations of the Spanish Rennaissance seem fitting and usually can be adapted to the requirements. No one seems to know just what the "modern style" is, but some examples of it seem not out of place in waterworks construction, if the freakish and bizarre are avoided.

Much of the success or failure of a building from the artistic point of view depends upon proper supervision of its construction and finish. Here again close cooperation between architect and engineer is necessary. Few architects or their superintendents are by training or experience qualified to supervise the highly specialized mechanical installations in these buildings. On the other hand, engineers are not by training, experience or temperament qualified to supervise the architectural features of the work and secure results that are satisfactory when scrutinized by those better qualified to judge. Much very unsatisfactory architectural work has resulted from supervision by those who were very competent in other lines but who with the best intentions erred in judgment when called on to pass upon matters outside the realm of their special training and experience.

Water Plant Built at Low Cost Holds Industries in Small Town

Old slow sand filter utilized as coagulation basin and old rapid filter becomes clearwell for new plant— Unusual filter gallery design saves existing pipe lines

By BURTON LOWTHER
Consulting Engineer, Denver, Colo.

IT IS A WELL-KNOWN APHORISM that good engineering consists fundamentally of good economics. In the waterworks problem presented in the following article a small town found it necessary to provide a supply of pure water in quantities out of all proportion to its population. The special solution of this problem made it possible for a small agricultural community to hold some large industrial plants by giving them a satisfactory water supply without overburdening itself with debt. EDITOR.

BY MEANS of economical design, utilizing to the utmost the existing units of two old filter plants, a small Colorado community was able to construct a new water-purification plant at a cost less than $9,000 per million-gallon-daily capacity. The low-cost plant was necessitated by the fact that, although the town has a population of only 1,000, the operations of the beet sugar industry required a large extension to its water supply. The new plant was built on the site of an existing purification plant comprising an old rapid filter unit and a slow sand filter. Two existing reservoirs, having a capacity of 75,000,000 gal., continue to serve the waterworks. The old rapid filter was reconstructed to serve as a filtered water reservoir for the new plant and the old slow sand unit was turned into a coagulation basin. The existing pipe lines were utilized as much as possible. A wooden washwater tank and steel piping in the filter gallery effected further savings over a more conventional design. The operation of the plant is so largely automatic that the attendant makes only two visits each day.

Johnstown is 50 miles north of Denver and 15 miles east of the Rocky Mountains, in the center of a rich farming community. Several industries utilizing the farm products of the neighborhood have located in the town, including factories for making beet sugar, condensed milk, industrial alcohol and dry ice and a plant for hulling peas. Several years ago a new sugar plant using the barium process was erected, requiring a large supply of pure water. As a result of the large amount used by these industries the average consumption for the town now approaches 1,000 gal. daily per capita. To meet the growing demand for more and better water, it became necessary for the town to rebuild its water-supply system if it was to retain its industries.

The existing plant supplying water to the town was 3 miles away. It consisted of 75 million gallons of storage in two reservoirs connected by a 10-mile irrigation ditch to Big Thompson Creek, a small rapid filter unit and a slow sand filter. The old rapid filter had been installed when the settlement had only six houses and consisted of a concrete chamber 14x25 ft. containing a filter 14x16 ft. In the design of this filter provision had been made for washing by utilizing a backflow from the reservoir, but the washing was not very effective, as the maximum head between the reservoir high-water level and the elevation of the sand in the filter was only 5 or 6 ft. The slow sand filter, built about four years ago, consisted of an open concrete chamber, 50 ft. square and 10 ft. deep. The effectiveness of this filter had gradually decreased until when the increased supply became necessary the sand had become tightly cemented so that no water could pass through except at a very small area where the gravel was exposed. A 14-in. steel pipe carried the water by gravity from the old filter plant to the distribution system in Johnstown. It had recently been necessary to build half a mile of 8-in. cast-iron pipe to the sugar plant supplementing its previous connection. Because of the large investment of public funds already

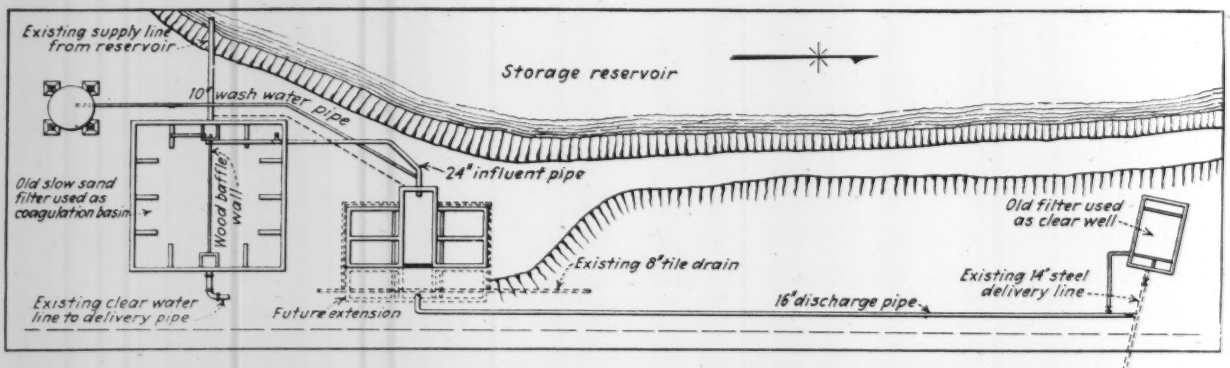

Existing supply line from reservoir
Storage reservoir
10" wash water pipe
24" influent pipe
Old slow sand filter used as coagulation basin
Wood baffle wall
Old filter used as clear well
Existing 8" tile drain
Existing 14" steel delivery line
Existing clear water line to delivery pipe
Future extension
16" discharge pipe

Fig. 1—Old filter units were utilized in building new waterworks plant by converting the existing slow sand filter into a coagulation basin and making over the old rapid filter unit into a clearwell. The new filter plant also makes use of three existing pipe lines: supply line from reservoir to slow sand filter, drain line from the old filters and steel delivery main to the distribution system

made in the existing plant, it became necessary for the town to spend the least possible amount in procuring its new water supply.

It was evident that every existing structure and pipe line must be made use of as far as possible in the new system. Every inch of water in the reservoirs was valuable, because of the possibility of a shortage during the winter months. It had been difficult and sometimes impossible to fill the reservoirs by means of the open ditch during times when the snow was deep and the temperature was low. It was further desirable to utilize as the influent a 12-in. vitrified-tile pipe line which had previously served as the influent line for the old slow sand filter; as an effluent line, the existing 14-in. steel line to the town; and as a drain, an existing mile-long sewer line from the old filter. To build another drain to the required grade a mile long would have been prohibitive in cost.

The old slow sand filter was transformed into a coagulation basin by removing the sand and gravel and installing an around-the-end wooden baffle. The existing control chamber at the inlet to the old filter was used as a mixing box for coagulating chemicals. Two new sluice gates were the only other additions to the structure. The old rapid filter was used as a clearwell.

The new plant is so designed that the filtered water in the clearwell throttles the filter discharge when the demand is less than the normal filter output. If the decrease in demand should come suddenly, the excess head of water on the filters flows over a weir into the washwater waste chamber connected to the sewer. In this way the plant is made practically self-regulating, and ordinarily the attendant spends only an hour in the morning and an hour in the evening at the plant, his other duties requiring his presence in the town during the remainder of the time.

The coagulating chemicals are applied by a dry-feed machine as the water comes from the reservoirs and enters the mixing box. Only one machine is used to feed the two chemicals, aluminum sulphate and sodium aluminate. The use of sodium aluminate is required by the necessity of raising the hydrogen-ion concentration during a large part of the year. It was not convenient to use lime for this purpose and satisfactory results were obtained with this combination of chemicals. The small amount of sodium aluminate required is finely ground and is mixed with the aluminum sulphate before being placed in the hopper of the machine.

The new filter plant consists of four units, each containing 127.5 sq.ft. of sand surface. The gravel bed is 15 in. deep and consists of four layers with a maximum size of 2¼ in. A 28-in. bed of Ottawa sand was used having an effective size of 0.45 mm. and a uniformity coefficient of 1.28. The cost of the sand was $4 per ton at Ottawa, Ill., and $15 per ton delivered. The substructure of the plant is of reinforced concrete and the filter house of timber, with weather boarding made of the used form lumber covered by a two-ply layer of roofing felt and then new ship-lap lumber. Heavy composition board is used on the inside for side walls and ceilings.

An orifice meter and a register were installed on the effluent line. All piping in the gallery 12 in. in diameter or less is of steel, with standard cast-iron specials. All valves are hand operated, with floor stands on the operating floor. Loss-of-head gages are of the float-and-chamber type, made at the plant.

The 26,000-gal. washwater tank is of redwood on a fir tower 25 ft. high. It contains enough water to wash two filter units. Its cost was only half that of a steel tank and tower. The washwater pump is installed in the pipe gallery and takes water directly from the filter effluent pipe. It has also an emergency connection with the influent pipe so that settled water can be used for washing if necessary. It is a 125-gal. per minute motor-operated centrifugal pump automatically controlled by a float switch in the tank.

The filter plant has a capacity of 1½ m.g.d., based on a rate of filtration of 2 gal. per square foot per minute. During periods of heavy turbidity the capacity is lessened. The peak demand on the filters is 2 m.g.d. The effluent is of high quality free at all times from tastes and odors, although the shallowness of the reservoirs favors rich vegetable growths. Treatment of the reservoirs with copper sulphate once or twice a year is sufficient to inhibit the growth of micro-organisms.

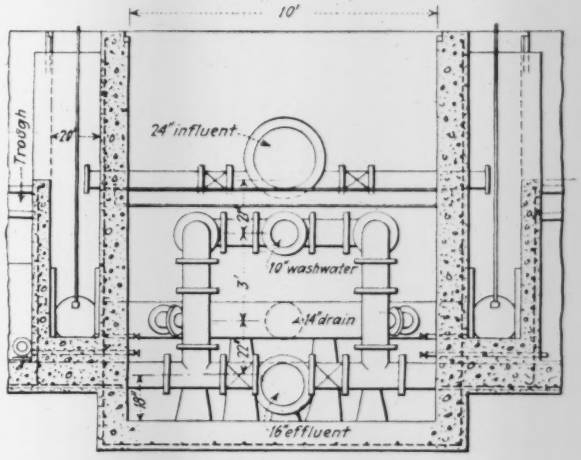


Fig. 2—Washwater drain line in gallery in above effluent piping. This unusual design was made necessary by the elevations of the existing pipe lines

The contract price for the new plant was $16,000, which included all the new structures and alterations and the piping but not the washwater pumps or the chlorinator. Excavation for the filter and pipe lines was difficult because of the heavy muck that was encountered. The work was done during exceptionally cold and stormy weather of the winter of 1929-30, which materially added to the cost of the work. It is a safe estimate to place the investment at less than $9,000 per million gallons daily.

The new plant was constructed by the Spotts Construction Co., of Loveland, Colo. The writer served as consulting engineer.

New Town Planning Scheme for Rome

Within a few weeks the Italian government is expected to pass a law to give the necessary sanction for beginning work on a new town planning scheme for Rome which will take fifteen years to complete. One of the most serious problems to be overcome arises because of the fact that the busiest streets are those of medieval times, particularly the Corso Umberto. This problem has been solved by projecting a system of new parallel streets and by the introduction of subways—hitherto unknown in Rome.

Huge Intake Lagoon Built to Avoid Ice Troubles

New Detroit waterworks intake with capacity of 940 m.g.d. located in lagoon formed by building dikes in Detroit River— Low approach velocities discourage formation of frazil ice

By TORRIS EIDE

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AVOIDANCE of the operating difficulties resulting from the presence of frazil or needle ice in the water during winter weather was a determining factor in designing the new intake for the Detroit water-supply system. To provide for the future extension of the waterworks facilities the intake has a capacity of 940 million gallons daily (940 m.g.d.), which is the estimated maximum-day demand of the system 30 or 40 years hence. As frazil ice does not form beneath an ice sheet on the surface, a wide expanse of slowly moving water was provided by placing the intake structure within an artificial lagoon in the Detroit River. The dimensions of the lagoon are such that the approach velocity will approximate 3 in. per second for two hours or more before entering the intake parts. The new intake is connected to the waterworks structures on the shore by a 15½-ft. tunnel built in rock. Another tunnel in clay provides a connection to the existing intake, which has been in service more than 25 years. The location of the new point of intake was determined by the results of sanitary surveys of the river, by the topography of the river bottom and by navigation requirements.

The Detroit River has been the source of public water supply for Detroit since the first simple provision, a town pump, was made in 1824 near the foot of Woodward Ave. The municipality acquired the waterworks in 1836, and with the growth of the city the point of intake has been moved upstream. Water was supplied from the Waterworks Park station, about 4 miles upstream from Woodward Ave., in 1876. Three intake pipes, 5 or 6 ft. in diameter, were laid, the last (in 1890) extending from 1,000 to 1,600 ft. into the river and drawing water through submerged intake cribs. The present intake near the head of Belle Isle was put into service in December, 1905.

Fig. 1—New water-supply intake at Detroit is located in an artificially made lagoon in the Detroit River as a protection against frazil ice

The existing exposed intake is located in the American channel at the head of Belle Isle in about 29 ft. of water. The intake tunnel is 10 ft. in diameter, lined with four rings of vitrified brick, and the invert is 64 ft. below the river surface. It was designed for a maximum capacity of 150 m.g.d. when discharging into a storage basin from which the high-lift pumps drew their supply before the filtration plant was built. The low-lift pumps installed in connection with the filtration plant provided a much greater difference in head, and tests made in 1927 indicated that 400 m.g.d. could be supplied through the tunnel.

With the phenomenal growth of Detroit since 1910 it became necessary to consider increasing the water supply. In 1924 a commission of consulting engineers presented a report on an additional water supply for the city. This commission recommended the Detroit River as the most available source and a location near the present intake in the American channel above Belle Isle as the most satisfactory point from which to obtain the additional water supply; the carrying of this supply by gravity tunnels through the city to two new distributing centers, one at the northwesterly and one at the northeasterly limits of the city; the distribution of raw water only through masonry tunnels and therefore the locating of purification plants at the distributing centers; the provision in planning future works for an estimated population of 3,400,000 at some time between 1950 and 1960, requiring an average flow of 520 m.g.d.; the capacity of the new intake system to be sufficient to supply in an emergency the entire needs of the city on the maximum day, estimated at 740 m.g.d.

This general plan was subsequently modified in various details. Seating the caisson of the Springwells low-lift pumping plant in hardpan, as found advisable, permitted lowering the delivery elevation 15 ft. at that point without much increased cost, and in recomputing capacities an additional 10 ft. was allowed for the northeast plant. In supplying the entire city through the new system it was found that for the maximum day at least a 15-ft. river tunnel would be required to deliver 370 m.g.d., the safe maximum capacity of the filtration plant at Waterworks Park, at the desired elevation for the low-lift pumps. Subsequently a study was made of boosting the supply to the two new stations at some future date. Boosting 25 to 30 ft., thus increasing the supply to these stations about 40 per cent, was found feasible, and to provide for this contemplated boosting the river tunnel diameter was made 15½ ft. The maximum capacity of the new intake system without boosting will be 940 m.g.d., delivering 370 m.g.d. to Waterworks Park, 350 m.g.d. to Springwells and 220 m.g.d. to the northeast station.

Considerable study and investigation was made be-

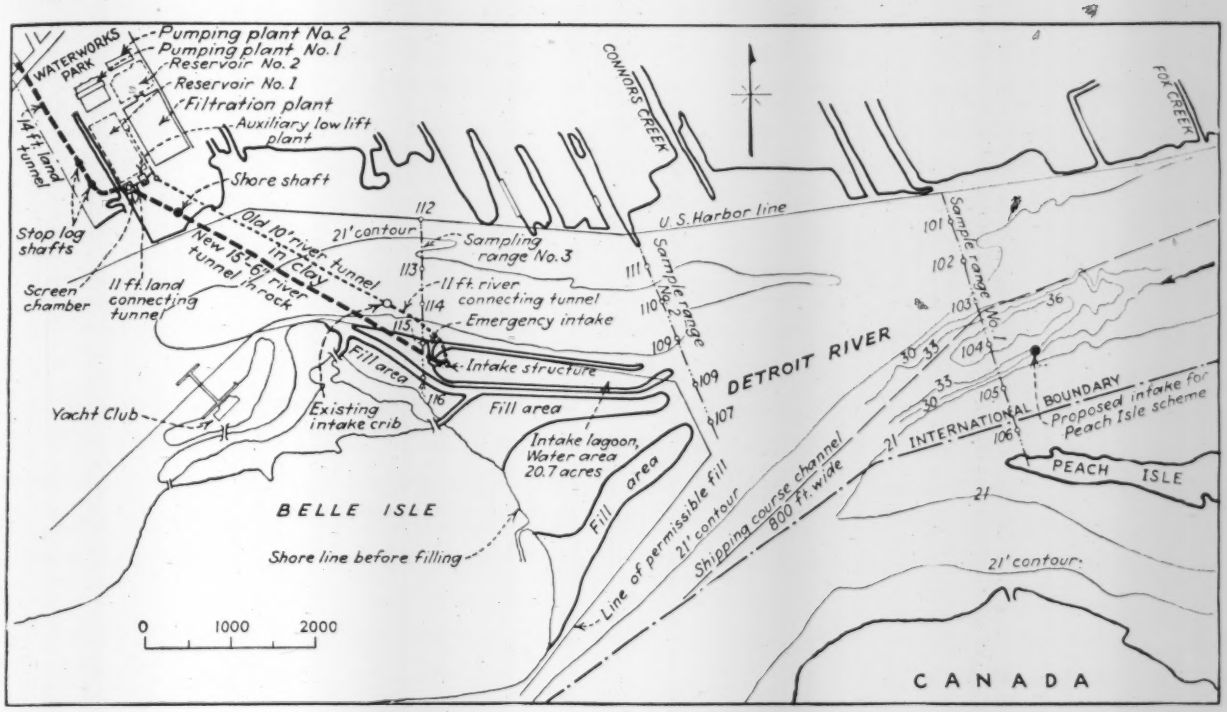


Fig. 2—New Detroit intake draws water from an artificial lagoon in the Detroit River
Tunnels connect the new intake with the old crib and with the shore structures.

fore the final location and type of intake and river tunnel were fixed. Connors Creek discharges into the Detroit River less than 4,000 ft. above the existing intake, and Fox Creek 10,500 ft. above. These creeks receive the domestic wastes and storm drainage from a large area of the city and, in addition, Connors Creek the wastes from large manufacturing plants. Control works on both creeks, including a large pumping plant on Connors Creek, now divert all the flow except the larger storm-flows to the river below the intake. These works were constructed to prevent flooding of the districts served and to decrease the pollution above the water intake.

Sanitary surveys of the Detroit River made in 1913 and 1915 showed pollution increasing as shown in the accompanying table.

Gross pollution was evident along the American shore, but due to the swifter current and the large flow in the river the pollution was found to decrease rapidly toward mid-channel. The pollution also decreases upstream, although between ranges 2 and 3 beyond mid-channel the difference is not great. Because of the better water the intake locations considered were practically confined to the strip between sampling stations 104 and 105, 108 and 109, and 114 and 115.

Floats also were released at Fox and Connors creeks. The course of these floats indicated that pollution from Fox Creek would occasionally reach the intake, but none from Connors Creek would. However, before the control works at Connors Creek were built, oil and greasy scum accumulating in the creek would sometimes under favorable wind conditions be carried over to the existing intake, the area affected on one occasion extending 2,000 ft. upstream.

These sanitary surveys indicated the desirability of locating the intake as far upstream as the physical charactertistics of the river between Peach Isle and Belle Isle permitted. The ship channel passing on a diagonal southeasterly between the two islands, and the shoal area, less than 20 ft. deep, extending from Belle Isle to the American shore opposite Peach Isle, practically confined

SANITARY SURVEY OF THE DETROIT RIVER

Average Number B. Coli Per 100 C. C.—Phelps Method

Range 1—Station		101	102	103	104	105	106	
	1925	111	27	21	25	5	7	
	1926	1,290	70	62	45	50	58	
	1927	315	7	4	11	5	18	
Range 2—Station		111A*	111	110A	110	109A	109	108	107
	1925	41,000	138	88	32	45	49	53	20
	1926	291,000	1,700	128	70	73	54	73	99
	1927	807,000	790	29	95	19	9	14	12
Range 3—Station		112*	113	114	115	116		
	1925	8,600	236	72	43	82		
	1926	51,800	5,400	167	95	50		
	1927	145,000	630	14	13	15		

*The large apparent increase for 1927 is due to carrying the dilutions farther when testing than in 1925 and 1926.

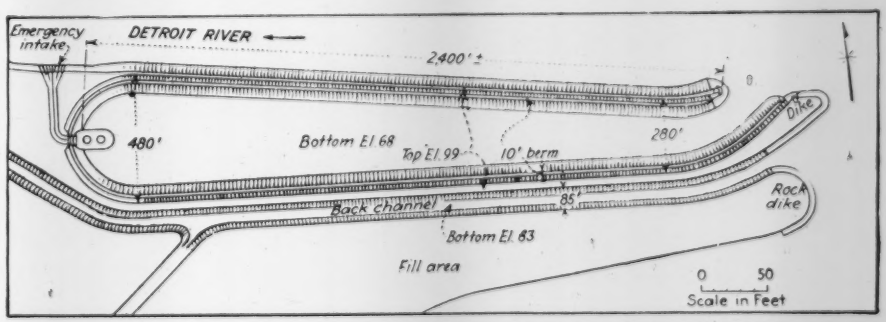


Fig. 3—An emergency intake is provided to draw directly from the river

intake locations to below Connors Creek and above the foot of this island.

Because of the better and deeper water near the foot of Peach Isle serious consideration was given to an intake at that point. This location would have required a tunnel 10,000 to 11,000 ft. long and 17½ to 18 ft. in diameter to develop capacity equal to that of intake locations below Connors Creek. The depth permitted placing an exposed intake outside the present ship channel in 28 to 33 ft. of water, and a depth of more than 36 ft. within the channel warranted consideration of a submerged intake. The

Fig. 4—The lagoon is formed by dredging and building dikes along the north side of shoal area above Belle Isle

present ship channel has a minimum width of 800 to 900 ft., and an exposed intake could be located in about 31 ft. of water so as to give a channel at least 1,200 ft. wide. An intake at Peach Isle, however, would cost from $1,000,000 to $1,500,000 more than one below Connors Creek, require twelve months more to complete if no intermediate shafts were used, and involve increased risk during and after construction because of its proximity to the heavy lake traffic. For these reasons and the probable difficulty in obtaining a permit for an intake at this location the scheme was abandoned.

Ice, since it may greatly reduce and at times even completely cut off the flow through the intake, is a source of trouble in localities having severe winter weather, and it was a controlling factor in determining the type of intake to be built. There are three forms of ice: sheet ice, which forms on the surface of the water, the increase in thickness taking place on the under side of the first thin sheet formed; frazil ice, also called needle or slush ice, consisting of needles, spicules or thin plates, which forms in open water at or near the surface when the water is cooled below the freezing point (only a very small amount of supercooling is necessary) through radiation of its heat into the air, and is prevented from forming sheet ice by agitation and currents in the water; and anchor ice, which forms on the bottom of a body of water as a result of the cooling of the bottom to the freezing point by radiation, possibly growing by the addition of frazil ice carried down by the currents.

Sheet ice and frazil ice particularly are the forms that trouble intakes in the Great Lakes region. Sheet ice when broken up may be forced by the wind, waves and currents against the intake and block the ports. In some localities these forces will ground the ice in depths of 20 ft. or more and pile it high above the water surface. Frazil ice adheres readily to objects at the freezing temperature and if it accumulates on the walls of the intake ports, it will obstruct the ports and even completely block them. In some instances the frazil ice has entered an intake in such quantities as to fill the central well about the shaft, necessitating blasting to remove it.

Currents of remarkably low velocity will overcome the buoyancy of the small particles of frazil ice and carry them down to the submerged intake ports. There is, however, no definite information as to minimum velocities, although it is stated that the velocity head corresponding to 0.2 ft. per second is sufficient to overcome the buoyancy of ice 0.016 in. thick. It is usually recommended that the mean velocity through the ports be not greater than about 0.5 ft. per second. An entrance velocity of 3 or 4 in. per second was recommended for Cleveland (1896), and the existing Detroit intake was designed for a maximum of 0.75 ft. per second. The Detroit maximum in the past few years, however, has exceeded 1.75 feet. The port area for the new intake is 1,615 sq.ft., giving a maximum velocity of 0.9 ft. per second for 940 m.g.d. and a mean of 0.67 ft. per second. Since the maximum winter-day consumption is 80 to 85 per cent of the maximum day for the year, the maximum port velocity for ice conditions will be 0.77 ft. per second. For a future boost of 25 ft. the respective maximum velocities would be 1.12 and 0.95 ft. per second.

Three intake schemes for locations below Connors Creek, taking water from a point about 3,200 ft. above the existing intake, were considered: an intercepting dike,

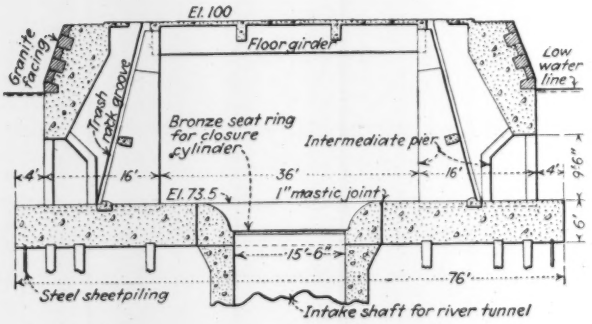


Fig. 5—Water enters intake from both sides and flows over foundation slab to tunnel shafts

an exposed intake and an intake lagoon. The intercepting dike, to be built by dumping rock into the river, would start 350 ft. below the existing intake, pass 150 ft. to the north of it and extend upstream 3,500 ft. so as to intercept any flow from Connors Creek. The intake itself, of the exposed type, would be located south of the dike near the existing intake. This scheme was the least expensive, had the shortest river tunnel and did not require a river connecting tunnel, but it was not considered feasible because the dike would interfere with the use of the American channel of the river and the restricted channel south of the dike might induce ice jams.

For the completely exposed intake, the second scheme to be considered, a depth of from 26 to 27 ft. was considered the shallowest desirable for adequate submergence of the intake ports. Since the pool or basin in which the present intake is located is deepest at the intake and gradually shoals upstream, 2,700 ft. is about the greatest distance at which the desired depth could be obtained. To locate a new intake 3,200 ft. upstream would, therefore, require dredging a cut at least 500 ft. wide, 800 ft. long and 5 or 6 ft. deep. Comparison with early soundings indicated, however, that this pool, as well as the deeper pool near the foot of Peach Isle, has maintained itself for over 50 years, and there was no apparent reason why the dredged extension should not do likewise. The

tunnel required in this case would be 5,900 ft. long and 16½ ft. in diameter. A connecting tunnel 3,000 ft. long and 13 ft. in diameter between the new and old intakes would increase the cost of this scheme considerably. To build a connection directly to the new river tunnel instead and to decrease the cost would reduce the flexibility of the two systems.

An intake lagoon is a departure from current waterworks practice. Its nearest counterpart is the large open forebay in some power developments. The chief function of the lagoon is to eliminate or greatly reduce ice troubles, especially from frazil or needle ice. Its ability to do so is based on the facts that frazil ice will not form under an ice sheet, that the ice sheet forms more quickly over a quiet body of water (as in a lagoon) than over agitated water, and that, given slow enough velocities and sufficient time, frazil ice carried in from the river will rise to the surface and adhere to the ice sheet before reaching the intake structure. Since there are practically no data available on the velocity that will permit frazil ice to come to the surface, the time required for the frazil to rise, the amount that will be carried into the lagoon, or the volume of storage required to hold any accumulation of ice without materially restricting the cross-sectional area and increasing velocities, the dimensions of the lagoon became largely a matter of judgment.

It was evident that to function properly the flow should be uniform over the lagoon cross-section and that the entrance should not face upstream. In order to determine the control necessary for uniform flow, a model was built on a scale of 1 to 33, representing a lagoon 875 ft. long from the downstream side of the entrance, or one hour of uniformly distributed flow, with a maximum width of 500 ft. at the water surface. Floats and dye were used to trace the currents. It was found that conditions at the entrance practically determined the minimum velocity obtained and the distribution of flow through the cross-section. The simplest, most effective entrance control consisted of three training walls followed by a double row of staggered baffle piles placed across the lagoon at the middle of the entrance curve. About 3 in. per second was the lowest velocity obtained with any consistency, and this was obtained only between a point 200 to 300 ft. below the downstream side of the entrance and a point 125 to 200 ft. from the intake structure. Assuming similar conditions at the entrance and intake ends for a longer lagoon, a length of about 1,350 ft. would be required to obtain one hour's flow and 2,300 ft. for two hours' flow, which was concluded to be the shortest advisable.

Though a lagoon offers a solution for ice troubles, there are drawbacks. Compared with an exposed intake it requires considerable maintenance in keeping the dikes and planted areas in shape and preventing the accumulation of rubbish. It also draws water from shallower depths, and the growth of vegetation in the lagoon may affect the water adversely.

The estimated difference in cost between an exposed intake and an intake lagoon was not sufficient to be determining. The lagoon was adopted since it was concluded that it would reduce ice troubles to a minimum. However, as a precaution against the blocking of the intake ports with frazil ice formed in the lagoon or blocking of the lagoon entrance, an emergency intake connecting the intake directly with the river was provided, controlled by gates opening automatically under a head differential due to a lowering of the intake level.

The shoal area at the head of Belle Isle afforded a favorable location for the lagoon, but its use was subject to the requirements of the department of parks and boulevards, which had charge of the shoal area within the "line of permissible fill" established by the War Department. The park department was engaged in filling a narrow area along the south side of the shoal with the intention of building a bathing beach. In order to reconcile the divergent requirements of a water-supply lagoon and bathing beach, the lagoon extending along the north side of the shoal area was separated from the park and bathing beach by a back channel for intercepting any flow from the beach and discharging it into the river far below the lagoon entrance. In addition, positive flow through the bathing beach lagoon, when constructed, would be maintained by large low-lift pumps placed at the downstream end.

The final length of the lagoon was fixed by the permissible extension upstream and the most favorable location for the intake shafts as determined by the borings. Locations 100 to 200 ft. downstream would have meant penetrating water-bearing sand under heavy pressure at a depth of 100 ft. The lagoon entrance was placed in 18 ft. of water in order to draw water directly from the deeper part of the river. The average depth over the lagoon area was about 8 ft. The lagoon was constructed by dredging to an average depth of 18 ft. below the river bottom and building a heavy rock dike along the river and a lighter rock dike backed by earth for landscape purposes along the back channel. The dredged slopes were riprapped. Piers consisting of a steel sheet-pile cell with wing walls, filled with concrete, define the upstream and downstream sides of the entrance and provide anchorage for the ends of a heavy timber boom. Only enough of the outer ends of the two training walls to provide support for this boom will be built at present. At the downstream end there is a refuse outlet connecting with the back channel for removing any refuse that may collect on the water surface.

The intake is an oblong structure with round ends and

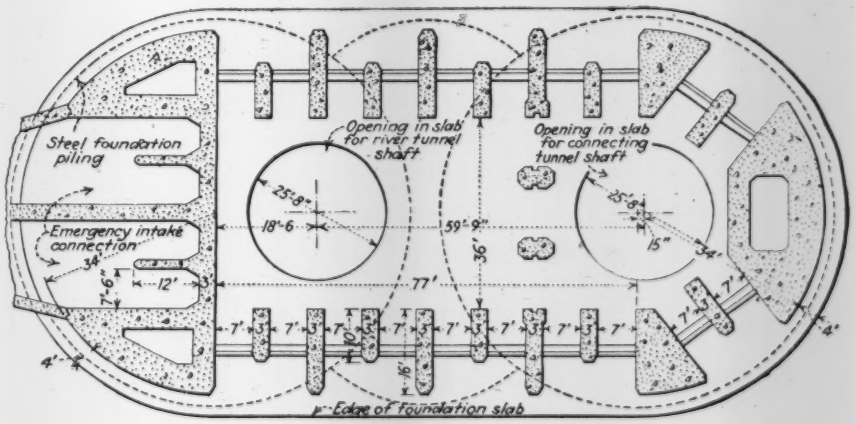


Fig. 6—Plan section of intake just above foundation slab. Openings in bottom slab of intake structure lead to river tunnel and connecting tunnel

ports along the side, placed out in the water like an exposed intake. The tests on the model indicated that this shape was to be preferred to a structure across the end of the lagoon with all ports facing upstream. The structure along the ports consists essentially of a number of equally spaced piers, the main piers 3 ft. wide by 16 ft. deep and the intermediate piers 3 ft. by 10 ft., which support a heavy curtain wall extending 7 ft. below low water, thus forming the intake ports. The ports, five on each side, are 9½ ft. high by 17 ft. wide, and just inside the curtain wall they are divided by the intermediate piers into two ports, 7 ft. wide, in order to provide for trash racks. Two piers with stoplog grooves divide the interior chamber into two unequal parts, the intake shaft for the connecting tunnel being located in the smaller upstream part and that for the new river tunnel in the larger. By using the trash-rack grooves for stoplogs either part may be isolated and dewatered.

In designing, a wind load of 30 lb. per sq.ft., or 1,200 lb. per lin.ft., was assumed as acting at the top of the piers, together with an unbalanced ice thrust of 14,000 lb. per lin.ft. at high-water level. One-half of these loads was considered as being carried to the piers on the opposite side by the floor girders spanning between them. The piers were designed as cantilevers with no restraint from the floor girders, with the foundation slab resisting this moment and that due to the bearing loads. The structure, except for a granite facing above the ports, is built of heavily reinforced concrete.

The bearing load, including water, is 2,600 lb. per sq.ft., assuming uniform distribution, and with no transverse distribution of the pier loads there is a maximum of 3,000 lb. The increase at the edge of the slab due to the horizontal loads is 600 lb. per sq.ft. For these loads it would be feasible to float the structure, but with the foundation slab practically resting on the bottom of the lagoon this was not considered advisable. A foundation consisting of two rings of straight-web steel sheetpiling ½ in. thick, within which was driven woodpiling 33 to 36 ft. long, was used. It was expected that the piling in the rings could be driven so as to bring the interlocks in tension or at least in bearing, but due to the movement of and pressures from the cofferdam the interlocks of many piles were not in bearing and the driving of the wood piles was not sufficient to bring them into contact. Because of this and the experience that in pulling sheetpiling clay would adhere to the piling and leave a void space of 1 to 2 in., the piles in the inner wall of the cofferdam were burned off near the top of the foundation slab. Measurements show a total settlement of 0.8 in. minimum and 1.1 in. maximum, most of which occurred when completing the lagoon dredging around the structure.

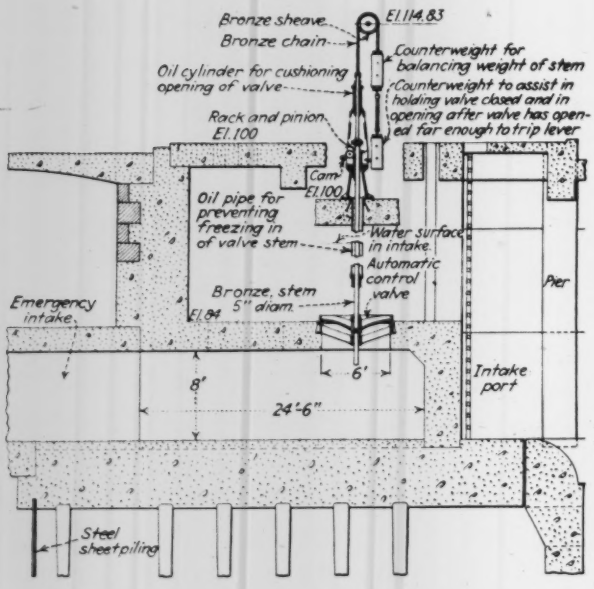


Fig. 7—Water from emergency intake flows upward through openings controlled by automatic valves

Valves are so balanced that when the level of the water inside the intake is 18 in. lower than the river level they will open automatically. Such a difference in head would result from serious ice blocking.

Fig. 8—The emergency intake consists of a double-barreled conduit connecting the main intake with the river

A cellular cofferdam was adopted in constructing the intake since it provided greater safety and would cause less obstruction to the work than a braced single-wall cofferdam. The average depth of water was about 8 ft. and the depth to the bottom of the excavation about 29 ft. The material varied from tough clay to a soft blue clay at subgrade. The exterior walls of the cells were a series of intersecting arcs tied together at the intersection points by straight diaphragm walls, common to adjacent cells. The cofferdam was made 25 ft. wide at the diaphragms. Straight-web piles, ⅜ in. thick, were used, the piles being 60 ft. long for the inside wall and 40 ft. for the outside and diaphragm walls. The design was based on a maximum stress of 6,000 lb. per linear inch of interlock.

The emergency intake is a double-barrel structure of reinforced concrete, each barrel being 13 ft. wide by 10 ft. high. There are eight ports, 10 by 10½ ft. at the river end, the structure contracting to the normal section in the next 80 ft. The intake velocity for maximum winter flow is less than 1 ft. per second. The emergency intake conduit enters the main intake structure at the west end where six control valves, 6 ft. in diameter, govern the admission of water to the intake. These valves are essentially large poppet valves designed to open automatically whenever the water in the intake is lower than in the river by some predetermined difference, 18 to 24 in. A counterweight assists in keeping the valve closed, and when the valve has opened a certain distance under the difference in head, a trip mechanism releases the counterweight so that it assists in opening the valve.

Construction of the intake was carried on under the direction of George H. Fenkell, general manager and chief engineer, department of water supply, and Frank H. Stephenson, assistant chief engineer. E. A. Prokop was design engineer and the author assistant engineer.

Water-Distribution System Development

An Unending Task

By F. H. STEPHENSON
Engineer of Water System, Department of Water Supply, Detroit, Mich.

CONTINUOUS city growth necessitates a continuous development of water-supply facilities. For the distribution system this means that pipe lines must be extended, strengthened and supplemented as the demand for water service increases. To assure an orderly growth a comprehensive plan must be evolved, and each unit of system enlargement should conform to that plan. Although the plan to be worked out for any particular city will be largely dependent upon its topography and industrial or commercial character, all plans must ultimately be based on the estimated increase in population and in water demand. In developing such a plan it is essential to study the records of consumption during past years in the various districts into which the service area is divided and to estimate their future population and industrial development. The amount of water required for fire protection is the final governing factor in the size of pipe necessary on individual streets. Where the district served is hilly, distribution reservoirs help to equalize the demands on pumping machinery and long feeder mains, but in flat cities booster pumps and elevated storage in tanks are necessary to relieve the peak demands.

Fig. 1—Elevated storage is of great assistance in maintaining pressures in a direct-pumpage system

The tank shown, of 2-m.g. capacity, was recently erected to reinforce part of the Detroit distribution system. It has a diameter of 79 ft. 2 in., and the overflow is 102 ft. 5 in. above the ground.

With very few exceptions the cities of today started as small communities. Their inhabitants obtained the necessary supply of water from wells and springs or a convenient lake or stream. As the communities grew, the wells and springs became inadequate or unsafe and the carrying of sufficient water from lake or stream became too burdensome. At this point in the life of the city we come to the beginning of a waterworks system. Years ago when this period was reached in our older cities nobody could foresee the enormous growth that would take place, and the usual water system was laid out to serve the existing community as economically as possible. With the continued steady urban growth many of the older cities inaugurated what were in their time stupendous waterworks undertakings, calculated to serve the community for all time. It has been interesting to read in water department reports of the completion of new projects the statements that the water-supply problem had been solved for an unlimited time.

The securing of an adequate supply for a rapidly growing community or metropolitan area, however, is but one of the problems to be solved. The supply may be secured, purified and made ready for delivery at one or more points in the area. From these points it must be distributed to the consumers for domestic, commercial and fire-protection purposes, and often over an area of hundreds of square miles. The problem presented is different for every area, and its solution is subject to the influence of existing physical, political and financial considerations. Certain fundamental data, however, are necessary in every case and must be secured, studied and given due weight in the solution of the problem.

Those charged with the task of planning and developing a distribution system to keep pace with the rapid growth and expansion of a city or metropolitan area generally find an existing system or systems in operation, representing a considerable investment that cannot be discarded but must be worked in with the larger system as economically as possible.

The first requisite is a comprehensive plan, prepared with the idea of meeting the requirements of the whole

area for a period of years. The length of this forward-looking period is influenced by the capacity length of life and obsolescence of the whole or parts of the existing supply works. It is not uncommon to plan ahead for a period of 30 years. The plan should present in some detail a bird's-eye view of the whole completed system, the general routes and sizes of the feeder mains, the boundaries of different service zones, location of reserve storage, booster stations and other data that may be of importance. It is probable that the plan will not be followed absolutely; but if it is well prepared, the changes will be of minor importance and will be because of some local condition that could hardly have been foreseen. A fundamental part of the problem is to predict as closely as possible the expected population of zones or districts within the area to be served and to determine how much water will eventually be required for each. If not already available, there should be prepared estimates of past, present and future population by districts, probable character of residences and stores and the number and kinds of manufacturing plants. One large utility corporation, in its estimates of future business, divides its service area into what it calls homogeneous areas or districts containing buildings of a marked similarity and inhabited by people who naturally make their homes in such an area. It will be found that consumption of water will vary with the type of residence supplied.

The estimate of the amount of water to be supplied to a district is generally based on an assumed per-capita consumption. The per-capita figure adopted is based on previous records of similar districts backed up or amended by the judgment of the designer of the system under consideration. With the steady increase in the use of meters on all services, the losses from unnecessary waste are being reduced, but the general low price of water and the rising standards of living will probably result in an increasing per-capita consumption. This fact should be given consideration.

Sources of Information

For predicting future population we have first the decennial United States census. This of course is a record of past performances, but it serves as a starting point from which to project a population curve into the future. The school census provides another valuable source of information. Many cities receive money from the state for school purposes based on a yearly census of the school population. This information is very useful, as the proportion of children of school age to the total population is reasonably constant. There are generally available estimates made by other agencies, such as the city directory, board of commerce and utility companies. The large public utilities are just as much interested as the water department in forecasting their future business needs and can be depended on to cooperate and exchange information. Some of these companies have secured and compiled most excellent data.

With the steady increase in the use of meters, both on consumers' services and on discharge lines from pumping plants or reservoirs, there is available much information relative to the consumption of water by all kinds of properties and manufacturing plants. The city of Detroit further analyzes water-consumption figures and segregates the quantities by meter sizes and is now making a similar study in those communities receiving water from the Detroit system. This information all helps in predicting future consumption. Many cities have had water-waste surveys made, and this work divides the territory into districts and subdistricts in which the amount of water used is determined. While the major reason for making a survey of this kind is elimination of waste and leakage, the information is valuable for distribution studies. Trunk-main surveys of existing feeder lines show the amount of water they are now carrying and the friction losses. This information is an indication of the effect of years of service on the carrying capacity of mains. Hydrant-flow surveys in existing districts help to determine the adequacy of design for new districts.

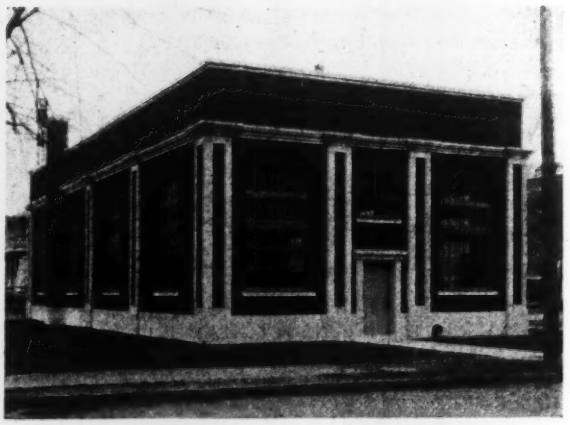


Fig. 2—Booster pumping stations sometimes are necessary when pumping great distances

This plant is located in a residential district in Detroit. There is no suction well available, the pump suction and discharge piping being connected directly to a large feeder main in the front street.

Where the distribution of water is entirely dependent on continuous operation of pumps with little or no storage, records of maximum, average and minimum consumption must be studied and provision made for maximum use. The relation between maximum and minimum hourly consumption in a period of one year may be as high as 4 to 1. The relation between maximum hour and average hour may vary between 1.5 and 2.0 to 1. The same conditions will apply in a lesser degree in gravity systems, for when a system receives its supply from a large reservoir no regulation of pumping is required to meet widely varying demands.

No mention has yet been made of the topographical and physical features of the districts to be served. Topographic maps, plans of major improvements and actual surveys are all important sources of information and have a direct bearing on determination of district limits, division into service zones and possibility of interruption of service. Natural or artificial watercourses, depressed or elevated railway tracks, highways, large sewers and drains all have considerable bearing on the design of the distribution system, and present conditions and proposed additions or changes should be given consideration.

Basis of Design

Having collected all available information, the designer is ready to develop his distribution plan. He must, however, determine what ranges of pressure he can allow in any district, what main-line friction losses should be considered reasonable, and whether or not storage or duplication of supply mains is warranted. In developing a new plan to fit in with and enlarge an existing system, cut-and-try methods are almost necessary.

The minimum pressure that should be maintained in

a district will be largely influenced by such factors as type of fire-prevention apparatus, height of buildings and whether or not there is a gravity or pumped supply of water. Probably 25 lb. per sq.in. is about as low as should be considered at any time in a purely residential district. Pressures of 50 lb. per sq.in. or greater are desirable in the business districts. In continuous pumping plants it is desirable to install a control gage near the center of the district and receive regular reports from it. Fire department houses, where men are always on duty, make convenient control stations.

In a system dependent entirely on pumping the flow in these mains may vary considerably, and they should be of such size that where centrifugal pumps are used the head variations should not be beyond the economical limits of the pumping units. In order to keep the friction losses within allowable limits, the designer may be obliged to choose between one very large feeder main or two smaller mains. In many cases it is probably best to choose two mains and defer laying one of them until the demand for water requires it. It may be, however, that the street layout, present and proposed, is such that one large pipe has advantages over two smaller pipes.

Elevated Storage and Booster Pumping

In many places elevated storage in tanks or towers is of great assistance in maintaining satisfactory service. Some cities have erected large storage tanks that fill during periods of low demand, usually at night, and this storage is held until the hours of heavy demand, when it is gradually let into the distribution system. Detroit has found this procedure very satisfactory during the summer months. At other times the tanks ride on the line and exert a steadying influence on the pressure. They also serve as reserves in case of a failure of pumps or a break in the feeder system. When riding on the line an altitude valve automatically shuts off the flow into the tank when the desired height of water is reached and allows water to flow from the tank when the pressure from the distribution side falls below tank pressure.

Some districts may possess such topography or be so remote from the starting point of the supply that adequate pressures can only be obtained by re-pumping or boosting. In such cases a large storage, either elevated or below ground, is desirable on the suction side of the booster pumps. This is not always possible, however, and very satisfactory results can be secured by taking suction direct from pressure mains.

Pipe material varies widely. Some communities use only cast iron, and this material is in very general use for small pipes. Pipes made of plates of soft steel, wrought iron or special irons are now used in large sizes and rather heavy plate thicknesses. Concrete pipe, particularly the type in which a thin steel envelope is surrounded on both sides with a reinforced-concrete shell, has been used quite freely in recent years.

Having developed a plan for a distribution system expected to be ample for many years, it sometimes becomes quite a task to live up to it. It is hard to convince a real-estate operator that he should finance a 16-in. line past his property in order that his neighbor should have water, when a 6-in. line might serve his 40 acres. The only solution is for the agency that supplies the water to secure and maintain sufficient control and insist that its plans be carried out. These questions are generally settled by others than the designer of the system, but they are of great importance in the proper building up of the distribution system.

Concord, N. H., Drives 150 Wells to Avert Water Shortage

CONCORD, N. H., long dependent upon Penacook Lake in the Merrimac River valley for its water supply, has turned to the Soucook River valley east of town for additional water. In a low-lying area close to the river 3 miles from the city, 150 wells, which yield a total of 1,500,000 gal. daily (1.5 m.g.d.), have been driven 45 ft. to rock. The cost of the new development was $150,000. Contracts were let for the pumping equipment and pump house, but forces of the city waterworks drove the wells and laid the pipes, including the main to the city.

Concord, with a population of 25,000, requires from 2.8 to 3.0 m.g.d. An all-year supply of not more than 2.6 m.g.d. can be depended upon from Lake Penacook. Original plans for an extension of the supply contemplated a dam and reservoir on the Soucook River. However, a threatened serious shortage in the lake supply last fall demanded quick action. As a result the Soucook Valley was developed as a multiple-well supply.

Work on the project started last November, and by

Fig. 1—Homemade rig driving one of 150 wells for Concord, N. H., water supply

February of this year 100 wells had been driven and were put into immediate service by a temporary electric motor-driven fire pump. Each of the 150 wells of the completed system is producing an average of 10,000 gal. daily. The draft on individual wells has been kept low to retard the tendency of the water to increase in iron content.

Because of the hilly topography of Concord about one-third of the supply has to be pumped, the remaining two-thirds being distributed by gravity. All of the Lake Penacook water is chlorinated, but the new well supply is being pumped directly into the mains without treatment. Although the iron content in most of the underground water in this district is high, water from the wells was found to be extremely low in iron, containing but 0.05 part per million.

The 150 wells are located along several header pipes converging into a 12-in. main line feeding the pump station. Except for a short section of 10-in. pipe, all headers are 8 in. in diameter. Fig. 2 shows a layout of the wells and piping system. The wells are located 10 ft. off the header lines, staggered on each side of the pipe at 40-ft. intervals. All pipes are graded to drain

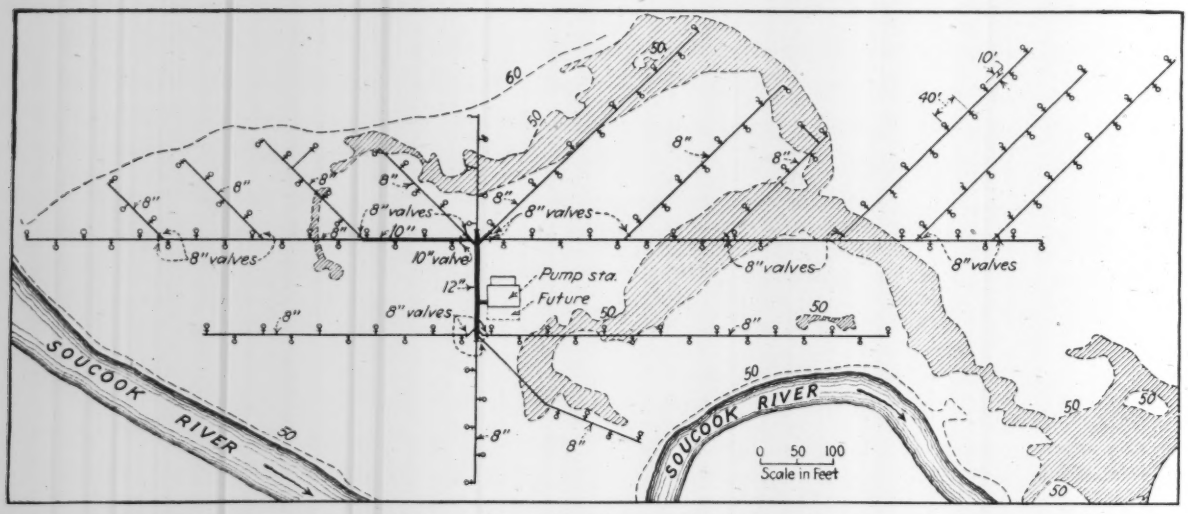


Fig. 2—The 150 wells are located along 8-in. pipe lines diverging in all directions from a centrally located pumping station

toward the wells. A 12-in. main leads from the pumping station to the city's distribution system.

Six permanent test wells have been driven in the pumping area. These will remain open to serve as gages of groundwater level. A log of a typical well hole shows that the top 1 ft. is a loam, underlain with a fine sand extending to ledge rock, about 45 ft. below the surface. Water is found from 6 to 8 ft. below the surface and extends all through the sand formation to rock.

A hole 7 to 8 ft. deep was dug with a post hole auger for the start of each well. From the bottom of these holes an extra-heavy wrought-iron pipe 2½ in. in diameter was driven to rock in 5-ft. sections. No shoe or point was used on the first section. After each 5 ft. of progress the dirt inside the pipe was washed out by means of a high-pressure jet, the water being supplied from an adjoining well. After the pipe had been driven to rock and thoroughly cleaned out, a 2½-in. brass strainer 6 ft. long and with an effective opening of 0.030 in. was dropped to the bottom of the pipe. The casing was then lifted until its bottom was nearly to the top of the strainer pipe, and the top of the strainer was then swedged out tight against the inside of the casing. Each well was given a test run by a gas-driven diaphragm pump. Sometimes it was necessary to raise the piping and strainer several feet to get a maximum flow. A constant check was kept on the carbon dioxide and iron content of the water by testing samples in the field from the individual wells as they were driven.

Two rigs were used for driving the wells, each consisting of a four-legged frame, a heavy iron drop hammer and a continuous windlass operated by a single-cylinder gas engine mounted on an old automobile chassis (Fig. 1). Power for lifting the hammer was supplied by the windlass through a few turns of the hammer line around the drum. The hammer usually had a free fall of 18 in., and was guided by a bar attached to it and extending down the inside of the pipe. A portable force pump supplied jetting water. The average speed in driving was one completed well per day by each of two crews.

The pumping station is centrally located within the well fields so as to avoid undue friction in the suction lines. It was considered advisable for this station to use centrifgual pumps rather than triplex pumps, which have been used generally in the past on driven well systems. The pumping equipment consists of two electrically driven 6-in. double-suction two-series pumps, each having a capacity of 1,000 gal. per minute against a 310-ft. head. The motors are wound-rotor induction type, 125 hp., 1,800 r.p.m. A stand-by unit consists of a 6-in. double-suction three-series pump of similar capacity driven by a six-cylinder gasoline engine of 180 hp., 1,200 r.p.m.

The use of centrifugal pumps made necessary the installation at priming apparatus to withdraw air from the system. Two vacuum pumps, with a capacity at 23 cu.ft. of air per minute at 10 in. of mercury vacuum, have been provided, each driven by a 2-hp. electric motor. One also has connected a one-cylinder gasoline engine in case of electric power failure. The supply to the centrifugal pumps is received through a combined sand chamber and vacuum tank 6 ft. in diameter and 12 ft. high. The primers automatically maintain a partial vacuum in this tank (Fig. 3), which provides automatic priming for the main pumps. It has been found that the priming can be held by one vacuum pump operating only 2¼ minutes every hour.

Contractors and Personnel—Metcalf & Eddy, Boston, were consulting engineers on the project, with W. R. Bradlee resident engineer in charge. All the pipe laying and well driving were done by city forces under the direction of P. R. Sanders, superintendent of waterworks. Starkweather & Broadhurst, Boston, were contractors on pumping equipment. The Norquist Construction Co., Concord, built the pump house.

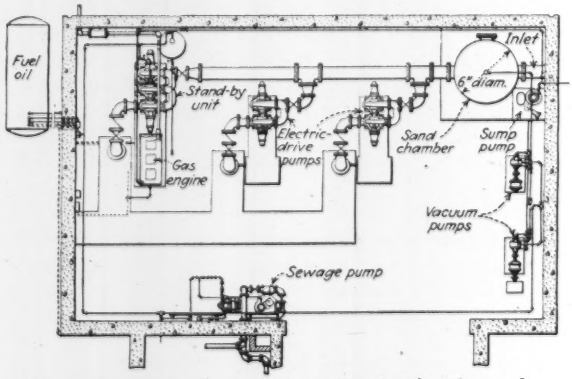
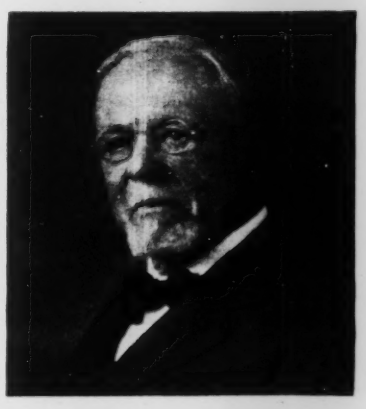


Fig. 3—Diagram of pumping equipment for Concord's multiple-well water supply

Fayette F. Forbes

Dean of New England Waterworks Superintendents



On construction of the Brookline waterworks in 1873-75 and superintendent ever since—Pioneer in water microscopy for control of algae growth and in water-waste prevention

FROM the first day of surveys for the waterworks of Brookline, Mass., on through their construction and the entire period of their operation to date Fayette F. Forbes has taken an intimate part and for 56 years has served as engineer and superintendent. During that time Brookline's population has increased from 7,000 to 50,000. Meanwhile the works have grown correspondingly in extent and much more rapidly in problems met and solved.

Outstanding in Mr. Forbes' services to Brookline is his work in maintaining, extending and improving an underground source of water supply for more than half a century. Elsewhere underground supplies have been progressively abandoned because of inadequacy or because of tastes and odors from algæ growths after exposure to the light, or a plague of red water after exposure to the air. Mr. Forbes mastered the algæ, the iron and with it manganese. For more than 50 years he kept up the adequacy of the underground supply by adding wells and extending the original filter galleries and by control of waste. Authority for further extensions of the source of supply being refused by the state on the ground of interference with other cities, the town finally was compelled to join the metropolitan water system in 1924, but not until 1929 was water taken from that source.

Pioneer Use of Microscope

In the use of the microscope to learn the cause of tastes and odors in the water supply under his charge and to put his findings into successful use Mr. Forbes was a pioneer. He was probably the first general superintendent of a waterworks plant to enter this field and almost the only one to continue in it. Diligent use of the microscope, beginning in the late 1880's, enabled Mr. Forbes to determine the kinds of algæ that infested the Brookline groundwater after storage in an uncovered reservoir, as well as those most responsible for tastes and odors. He found that when the pumps delivered the water directly to the consumers the algæ caused no trouble. This method was used from time to time, but finally increased consumption made it inadequate and complaints of taste and odors increased. Meanwhile adding a cover to a water tank stopped algæ troubles in the high-service system, and in 1893 a covered reservoir was built.

In 1912, some years after the original filter galleries were supplemented by driven wells, highly colored water from house faucets led Mr. Forbes to experiment on the removal of iron and manganese from the water. The method tried, although similar to that successfully used elsewhere and at Brookline, was found to be so costly that Weston & Sampson were called on to make other experiments. These showed that aëration by means of coke tricklers followed by filtration would remove the iron and manganese, and a plant of that type was built.

Water-Waste Prevention Campaign Began 50 Years Ago

Mr. Forbes' campaign against water waste began 50 years ago. It was almost as unusual for that day, and considerably earlier, than his use of the microscope for the control of algæ, tastes and odors. In 1881 the Charles River fell 7 in. below its record. In June the filter galleries yielded not more than 1,000,000 gal. a day while the water consumption ran up to 1.2 m.g.d., or 2½ times the average for the year. Stimulated, presumably, by this condition for 39 days scattered through each month from June to December, 1881, Mr. Forbes made observations on the falling water level in the reservoir between 12 and 4 a.m., while the pump was idle. Allowing for a small amount of legitimate use in those early morning hours, he concluded that the waste totaled 210,000 gal. a day, or 44 per cent of the average daily consumption. A house-to-house inspection cut the leakage, as Mr. Forbes termed it, by 100,000 gal. a day, but "this lasted for a short time only," showing that to keep the waste down "a regular monthly inspection would be necessary." This pointed to the adoption of meters (only four then installed), but although the water board soon began to urge their use the number installed at the close of 1888 was less than 160. The first step toward a general meter system was then taken and by Jan. 31, 1890, there were 576 meters on private services.

It was not until Dec. 28, 1904, that a universal meter system was authorized by a town meeting. Then there was rapid movement, for in May, 1905, or 24 years after Mr. Forbes began his waste-control campaign, all water services were metered.

Mr. Forbes has contributed a dozen technical papers or discussions to the New England Water Works Association, all relating to his work at Brookline. Three of these embody results of his studies of microorganisms in water; two were on driven wells; and one each on the automobile for business, cement-lined service pipes, compulsory meterage, one of his covered reservoirs, frictional head in a force main, improvements in pumping engines and lead poisoning.

Modernization of the Distribution System and Its Accessories

Higher standards of service demanded by consumers force progress in water utility facilities, made available through advances in science and in parallel activities

By H. W. GRISWOLD
Deputy Chief Engineer, Water Bureau of the Metropolitan District, Hartford, Conn.

PERHAPS nothing about a water utility is quite so stable or has quite such a long life as the distribution system. Mains do not wear out, valves 50 to 75 years old still in place are not uncommon, and service lines last indefinitely. In consequence the modernization of this static, stable, and old yet active and operative part of a waterworks plant might at first blush seem not particularly subject to the influence of the new and up to date. Mr. Griswold soon dispels such a thought, and clearly carries the reader's mind throughout the range of the underground labyrinth, pointing out at every turn modernization agencies at work taking full advantage of all that science and experience in kindred lines has to offer. —EDITOR.

MODERNIZATION of a distribution system of a water utility is an evolutionary process—a continuous change from older to newer standards—and is the tangible resultant of many of the same intangible forces that have brought about the modernization of our cities, towns and industries. Progress is comparatively rapid when consumers demand a higher standard of service and there is a lessened spread between income and outgo. This movement tends to slacken when consumer standards are realized and when costs are at a constant level or decreasing.

During the last decade many water utilities have experienced rising costs and nearly stationary income. Consumers have availed themselves of the new developments in plumbing and have demanded not only a safe and attractive water for domestic use but also an adequate flow at all times to serve their two- and three-bathroom homes. Fire protection has been stressed by the fire fighter, by the manufacturer of fire-fighting equipment and by the insurance underwriter and his laboratory, while advances in science and the modernization of communications, industry and transportation have made available to water utilities many new processes, materials and tools. These conditions have been favorable for the adoption of new standards for the design, construction and maintenance of every part of the distribution system from feeder main to consumer's shut-off.

The gate valve of today (at the left) is sturdier and more compact than the old 20-in. valve (at the right), which dates from about 1870

Choice of Material for Mains Has Widened—Cast iron has been the most generally accepted material for feeder mains and is still quite largely used, but in the larger pipe sizes steel plate, wrought-iron plate and precast concrete pipe are strong competitors. Pipe fabricated from rolled plate may have longitudinal seams riveted, welded or fastened together by a lockbar, and circumferential joints may be riveted, welded, bell-and-spigot or clamped. Cement and bitumen linings have been developed for this type of pipe and the exterior is often wrapped with fabric embedded in asphalt mastic. Hot dipping is generally employed when the pipe is not lined or wrapped. Concrete pipe is made both with and without a thin welded steel cylinder. The concrete shell is reinforced with sufficient steel to resist the bursting pressure and to each end of each length is fastened a steel ring to form the joint. In some types the joint consists of a lead-and-jute gasket rolled between the rings; in other types various forms of sleeve joints are used, but all types are finished smooth at the joints on the inside of the pipe with cement.

Cast iron is still the most popular material for distribution mains 20 in. and smaller, but a considerable proportion of the pipe used today is centrifugally cast instead of pit cast. The iron in centrifugal pipe has a better structure and greater strength than that in pit-cast pipe and the centrifugal process gives a more uniform product and a lighter and somewhat cheaper pipe for the same strength. Linings of cement and bitumen compounds which can be spun into the pipes are available, but the older process of hot dipping into coal-tar pitch varnish is still used.

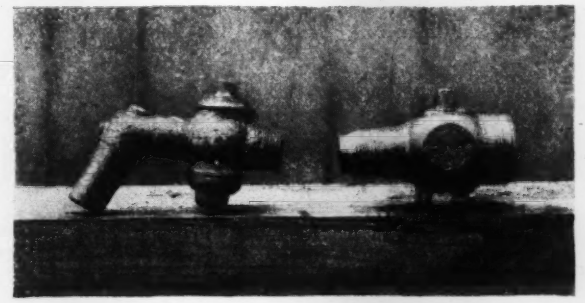
System Details Improved—Little change has been made in the design or manufacture of fittings or special castings, but a recent series of tests on American Water Works Association (A.W.W.A.) specials is furnishing the groundwork for a new set of standards. Short-pattern specials are manufactured and there has been some progress in applying cement and bitumen linings to fittings.

The use of tapping sleeves and gates for taking off branches under pressure, instead of shutting down the

main and inserting a branch, has become standard practice.

In addition to the bell-and-spigot and bolted-flange joints which have been in general use for many years, there are available several types of clamp joints for plain- and grooved-end pipe, a combination ball-and-bolt joint and in the smaller sizes a screw joint. For subaqueous and high-pressure work several special types of joint have been developed.

In jointing material the high cost of lead and of labor for digging bell holes and for calking has given impetus to the introduction of lead substitutes. At least three brands of joint compounds are now in general use. For joints difficult to run with these compounds or with hot lead, lead wool has been used satisfactorily. As oiled jute cannot be used with joint compounds, it has been replaced either with loose unoiled jute or with square



The drive-type corporation cock (at the left) has been replaced by a stronger cock (at the right) adapted to installation under pressure

braided packing. The coal- or wood-burning lead furnace is now heated by a gasoline or a kerosene blast burner.

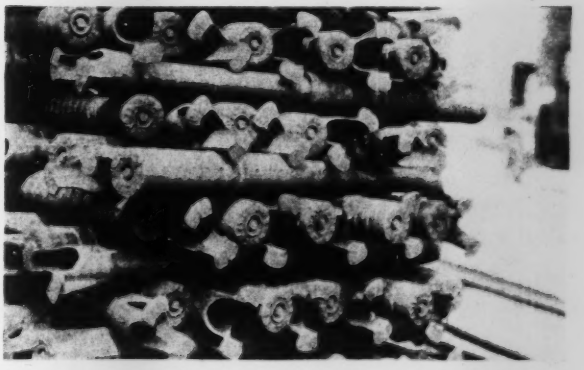
In many distribution systems each new main is tested under pressure and sterilized with either liquid chlorine or hypochlorite before being put into service. The standards for allowable leakage, the apparatus for sterilization and the tests for residual chlorine after flushing have not been applied to distribution system work until recent years.

Wastes Better Controlled—To detect and control leakage and waste of water in the distribution system pitometer surveys are used successfully. Apparatus has been developed to give a continuous record on sensitized paper of the flow into a section of the distribution system, and if, from a study of this record, there appears to be excessive flow into the district, by putting on another chart and closing off one street at a time it is possible to locate the leak or excessive use of water closely.

Storage within or near the limits of the distribution system is receiving more and more attention in an effort to reduce the peak loads on pumping stations and purification plants. This storage usually takes the form of reservoirs for large storage and standpipes or elevated tanks for smaller storage. The increasing use of filtered water has made it desirable to cover over all such storage structures. Electrical and mechanical devices are on the market for indicating and recording elevations of the water in storage.

Stronger Valves—Distribution system valves in general are still of the solid-wedge, split-wedge or double-disk types, but many improvements have been made in materials and operating mechanisms. Bodies are made of either high-grade iron or steel, stems of high-strength bronze or stainless steel, and special alloys are sometimes used for disk rings and bolts. Brass or bronze bushings and facings are more frequently used than formerly and gear trains are often housed in cases designed to give continuous lubrication to the gears during operation. Indicators of sturdy construction are standard for the larger valves, and the key valves of the system are sometimes built for electrical operation with remote control and indication. For special purposes hydraulically operated valves and special design valves are now available. Check valves, altitude valves and pressure-reducing valves have been improved in design and operation and there are many interesting applications of these types of valves to distribution system work. The extended use of street paving has led to an increasing use of pits for housing gate valves, even in the smaller sizes. For these pits designs have been developed for the use of standard steel forms and precast steel or concrete units.

Larger Services—The increase in rate of demand per consumer, occasioned largely by the increasing use of flushometer valves for toilets, has resulted in a general increase in the minimum size of service pipe. Diameters of $\frac{1}{2}$ in. and $\frac{3}{4}$ in. are not in as general use as formerly; the 1-in. size is the most common size, with an increasing number $1\frac{1}{2}$ in. and 2 in. in diameter. Larger sizes for apartments and office buildings and for sprinkler



Stop boxes are now made with the top integral with the barrel. A stock pile of the new boxes in a waterworks yard

and other fire protection service are also in more common use.

The materials available for service pipe have been increased by the addition of copper tubing. Special plate and cast irons in the $1\frac{1}{4}$-, 2-, and 3-in. sizes. Lead, wrought iron, steel and brass continue in general use, but in some localities because of water or soil characteristics the choice of material may be limited to only one or two of those listed.

Wrought-iron and steel pipes may be obtained with either cement or lead linings and there are various wrappings and coatings available for protecting the outside of these pipes against soil corrosion in addition to the standard galvanizing process.

In some cases lead goosenecks for connection to the corporation cock have been superseded by the swing joint made up of standard pipe fittings and nipples, and in others goosenecks of copper tubing are used in place of lead.

Fewer Shutdowns for Connections—The standard material for service pipe connections other than couplings and unions continues to be brass. The old

drive type corporation cock is no longer on the market and its successor is a heavier and better made article equipped for insertion into the main under pressure by the use of the corporation tapping machine. Interruption of consumer service to allow dry tapping of the main is no longer considered good practice. There is an increasing tendency to insist that a shut-off be installed on each service, usually at or near the street line. In the smaller sizes these, like the corporations, are ground plug cocks, but for the larger sizes brass or iron bodied gate valves are usually preferred. The boxes over these shut-off cocks are often of the small telescopic

A 50-year old valve recently removed from the Detroit system

type, with top section about 1 in. in diameter containing a shut-off rod attached to the T-head of the cock, instead of the larger cast-iron box formerly used.

Meter Modernization—While the sale of water by meter is nowhere near universal, the tendency of modern practice is more and more toward the installation of a meter on every service with master and district meters serving as a check on consumption. The displacement disk meter remains the standard for house service. Modernization has been confined to refinements in construction, such as a more extended use of Monel metal and hard rubber for parts, oil-inclosed gear trains and frostproof bottoms. Special settings have been devised for installations both inside buildings and in boxes at the street line. In the larger meters much progress has been made on fire-flow and compound meters. Several types are manufactured which have a high accuracy at small flows and a small loss with fire flows. In addition to the Venturi type of master meter, the orifice, turbine and Pitot-tube types are available. Each of these may be equipped with long-distance electrical indicators and recorders. Mechanical and electrical attachments are available also for these and for other types of meters for determining rates of draft, for maintaining constant rates of filtration and for controlling chlorination.

Autos Force Hydrant Changes—The change in type and amount of traffic has been the greatest factor in the modernization of the fire hydrant. Years ago the single hose outlet was increased to two or more and with the advent of the pumper the steamer outlet was added. The main types, however—knuckle-joint, gate and compression—persisted practically unchanged until the coming of the automobile. The modern hydrant is most often of the compression or gate type and is so designed that if struck by an automobile it may be broken off without much if any leakage, or much damage to the working parts, and with the break confined to a section of the barrel, easily and cheaply replaced. The hydrant can be faced in any direction, the working parts removed without digging and the drip can be piped to the sewer to prevent freezing. Several traffic guards for hydrants are manufactured as well as equipment for thawing frozen hydrants. Standards for hose threads have been adopted and considerable progress has been made in changing over local standards to the national standard.

Labor-Saving Equipment Expensive—In common with all industry, the water utilities have replaced hand labor with machines wherever possible. Excavating machines, usually gas driven, dig the trenches and mechanical back-fillers replace the material. The air compressor and its various air-driven tools are used for breaking pavement, drilling rock, tamping back-fill, calking joints, cutting pipe, pumping out excavations and cutting clay. The motor truck, the motor car and the tractor are used universally for all the various jobs over which the horse

Large cast-iron pipe is being cut by air-driven tool in which cutters are carried by a revolving ring

formerly reigned supreme. Special truck bodies have been built for pipe hauling and for meter and service work. The larger utilities have special trucks equipped with gate-operating units, pumps, lighting plants and tools for emergency work and also maintain completely equipped service stations for their automotive and construction equipment. Cranes of various kinds handle the heavy material at the stockyard, and smaller equipment, such as concrete mixers, tapping and gate-inserting machines, pipe pushers and pumps, is largely used. Shops are equipped with modern machine tools, and factory standards and methods have been adopted in the machine shop, at the repair bench, in the stock room and on the testing floor.

More and Better Records—Distribution maps and

records are steadily growing in volume and importance. The day when the knowledge of gate and service locations depended on the memory of two or three of the older employees has passed. The modern utility has a record of each gate and service shut-off location in convenient form for quick and handy reference. Maps of the distribution system are kept up to date together with pressure, pumping and consumption records constantly available. Work-order and cost systems have been made available for water utility use and are usually tied in as an integral part of the accounting system.

Modern Business Aids—Standards for finances and accounting have been set up by the regulatory commissions of the various states and have been of great assistance in bringing into orderly form the essential facts about the business of the utility, have facilitated comparisons between utilities and have helped to promote abler management. The water utility's billing and collecting department has availed itself of the many business aids that have been developed in other industries. The billing machine, the computing machine, the addressograph, the cash register for the classification of receipts and the mailing machine, as well as the various types of card ledgers and files used by modern business, find a place in the water utility office. Constant volume of work is maintained by zone billing, and this also results in a more uniform flow of income.

From the electric utilities, the water utilities are taking over a new conception of consumer service, and from the same source have come new ideas of rate structure. The charge for water and the minimum bill still constitute the only rate factors in many water utilities, but others are realizing that fire protection, consumer rate-of-demand and readiness-to-serve are factors that merit serious consideration in future water-rate revisions.

The waterworks industry as a whole is conservative and its progress toward modernization seems to have been guided by Pope's couplet:

> Be not the first by whom the new are tried,
> Nor yet the last to lay the old aside.

Tunnel Driving at Cobble Mountain

Comparison of shooting and mucking methods and costs on two tunnels on Springfield's new water supply and hydro-electric project

By HARRY H. HATCH

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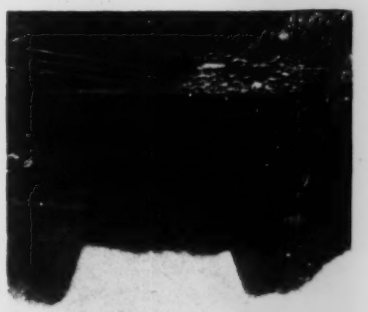
TWO MAJOR features of the construction of the Cobble Mountain project by the city of Springfield, Mass., on Little River were the driving of a 1,600-ft. diversion tunnel and a 7,100-ft. pressure tunnel. These two tunnels, nearly the same size and driven under similar conditions through similar materials but by different contractors, afford an excellent comparison of tunneling methods, procedure and costs. This article considers drilling, shooting and mucking in both tunnels. Subsequent articles will feature concreting, grounting and surveying methods.

The Cobble Mountain development is unusual in several respects. It is a combined municipal water-supply and hydro-electric project, costing about $6,000,000. Its watershed is only 46 square miles, yielding an average flow of about 90 cu.ft., and yet the development includes the construction of the highest hydraulic-fill dam in the world, 255 ft. from foundation to crest, creating a storage reservoir of 22 billion gallons capacity. (See *ENR* July 26, 1928, p. 124.) The power project will develop a minimum head of 330 ft., a maximum of 456 ft. and a working average of about 400 ft. Fig. 2. shows a general plan of the entire development.

The city of Springfield has contracted to sell the power developed to the Turner Falls Power & Electric Co. for $270,000 per annum for the next 30 years, without jeopardizing the full benefit of the ultimate development of its entire watershed for water-supply purposes. The Cobble Mountain project is a most opportune proposition for both the city and the power company. The city would have been unable at this time to develop its watershed to full capacity without the financial returns from the power company; and the latter has acquired the most important waterpower site within its territory to meet needed requirements, without any financial obligations other than the yearly payment of rental.



Outlet portal, Cobble Mountain diversion tunnel

The average daily consumption of the city at present is about 28 sec.-ft. The power company will draw this amount, or whatever the city requires for its daily use, every day during the peak load hours. More than one day's supply can be stored in an existing reservoir below the power house, enabling the daily supply to be drawn through the pressure tunnel at any time during a 24-hour period. The difference between the mean flow of the stream and the city's daily consumption will be impounded in the new reservoir for use, under certain restrictions, at the convenience of the power company. As the tunnel and the power plant capacities are ten times that of the mean flow of the river, the impounded yearly excess water can be drawn during as short a period as five weeks. The power company will use this water during dry seasons, when heretofore it had to operate steam plants to supplement its hydro plants.

Description of Tunnels

Diversion Tunnel—A diversion tunnel, an 11½x11½-ft. horseshoe section (Fig. 3), 1,550 ft. long, was the first structure to be built in the development. As can be noted from Fig. 2, the tunnel cuts across a bend of the river on a straight alignment. Besides serving to temporarily divert the flow of the river during the construction of the dam, the tunnel will have a two-fold

Fig. 1—Two intakes at different levels serve the Cobble Mountain pressure tunnel. Upper intake discharges directly into shaft; lower inlet leads through a long open cut to tunnel portal.

permanent value in controlling the 1½ billion gallons of water in the reservoir below the pressure tunnel intake, El. 830, and to serve as an outlet in case of extreme floods. The water stored in the reservoir below the pressure tunnel intake can never be used by the power plant, and will be held in reserve by the city for water supply during extremely dry years. There is little possibilty of a tunnel ever being used for flood discharge, as the reservoir spilway has a capacity of 20,000 sec.-ft. and the maximum flood recorded during the past 25 years was 5,800, sec.-ft.

The intake portal of the diversion tunnel is located 1,100 ft. upstream from the upper toe of the dam, far enough away to prevent any possible blocking of the portal by slides occurring during construction of the dam, as happened at Calaveras Dam several years ago. The entire tunnel is lined with concrete. The portal opening, 360 sq.ft. in area, reduces down to the standard tunnel area of 113.3 sq.ft. within a distance of 25 ft.

A shaft 219 ft. deep was sunk 345 ft. from the intake portal to house control gates and valves. At the bottom of the shaft there is an 18x24-ft. gate chamber 22 ft. high, over which is a 15x18-ft. control chamber 10 ft. high. The shaft and chambers are concrete lined, the shaft area being divided into equal parts by an 8-in. concrete partition wall. The tunnel and control works was designed to handle a discharge of 4,000 sec.-ft. with water at El. 810 in the reservoir.

Diversion Dam—In connection with the diversion tunnel, a rockfill diversion dam was built which later became the upper toe of the main dam. This dam is 75 ft. high and is 240 ft. long at the crest, with a crest width of 40 ft. In order to keep a channel open for the river before the tunnel was completed, it was necessary to build a timber crib to hold the rockfill in place. About 15,000 cu.yd. out of a total of 55,000 cu.yd. required by the diversion dam was supplied by tunnel muck, the rest being borrowed from near-by quarries. The upstream side of the diversion dam is faced with a rolled-earth section 10 ft. wide at the top and 25 ft. wide at the bottom to provide a watertight barrier.

Pressure Tunnel—The pressure tunnel has a total length of 7,080 ft. and is mainly a 10x9 ft. 4 in. horseshoe section, concrete lined, having a net area of 78.96 sq.ft. For the lower 450 ft. the tunnel changes to a 10-ft. circular section, with a $\frac{7}{16}$-in. steel lining, all joints welded.

At the intake end the tunnel has two inlets, one above the other, the lower at invert level, El. 830 and the upper at El. 900 (Figs. 1 and 2). The upper inlet consists of an open cut 20 ft. wide at the bottom, ending in two retaining walls which are part of the main shaft structures. The lower inlet consists of an open cut 450 ft. through solid rock, with a bottom width of 15 ft. A tunnel section 215 ft. long connects the bottom of the shaft with the open cut section.

The main shaft, 125 ft. high, is octagonal in shape, with a cross-section area of 320 sq.ft. up to El. 900, and is surmounted by a concrete gate house. The shaft contains a 12x13-ft. Broome self-closing sluice gate, operated by an electric hoist located in the gate house.

The surge tank is a steel structure 25 ft. in diameter and 207 ft. high, its top being 50 ft. above the maximum flow line of the reservoir. The bottom of the surge tank is 5 ft. above the top of the steel lining of the tunnel, the two being connected by a steel pipe 5 ft. 7 in. in diameter. Near the surge tank foundation the steel lining is connected to a manifold with three outlets leading to three penstocks, one 5 ft. 6 in. in diameter and two 7 ft. 9 in. in diameter. The penstocks are 660 ft. long with a 284 ft. drop in elevation. The power units consist of two 13,620-kva. and one 5,760-kva. generators.

Shooting and Mucking Methods

Diversion Tunnel—The diversion tunnel was driven entirely through solid sock, a mica schist characteristic of the region. At the beginning, during the excavation of about 400 ft. of tunnel, the contractor had several superintendents who tried different schemes of drilling and shooting, all variations of the heading and bench method. For the remainder of the tunnel the full-face method of driving was used, adopted after a trial. Experience showed that the heading and bench method required more explosives and more drilling per cubic yard of excavation than did the full-face method. Also in the heading and bench method considerable hand mucking was required to clear the bench before drilling could commence. The various heading and bench schemes required from 8.7 to 11.3 ft. of drilling per cubic yard of excavation, and from 5.2 to 7.7 lb. of dynamite per

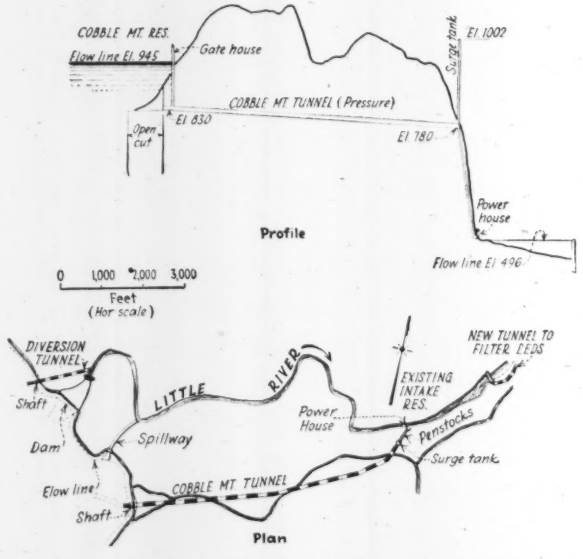


Fig. 2—Plan of Cobble Mountain development and profile of pressure tunnel

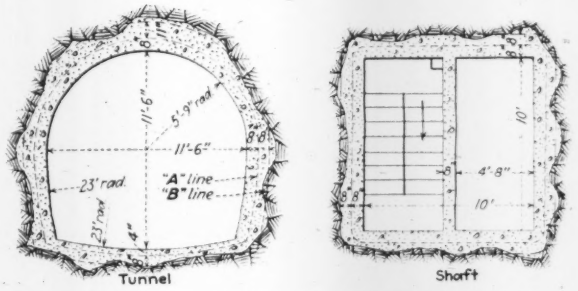


Fig. 3—Typical cross-sections, diversion tunnel and shaft

cubic yard. The full-face method averaged 8.7 ft. of drilling and 5.2 lb. of dynamite per cubic yard of solid rock excavation. Fig. 4 and Table I summarize the details of drilling and shooting methods.

For the most part, 60 per cent gelatin dynamite was used in shooting, with direct and several delay exploders. At first all the holes were tamped and backfilled with sand, but later additional sticks of dynamite were used for the same purpose. Headings and benches were usually shot separately, doubling the time lost in removing tools before shooting and for waiting after the shots for the heading to clear of fumes.

The drilling crew consisted of one foreman, six drillers and six helpers. At first, two ten-hour shifts were used per day, when drilling and mucking were done together. Then call shifts were used; sometimes the men worked two shifts in a 24-hour period. This method was soon changed to four six-hour shifts, two drilling and two mucking. The drillers, though working but six hours, were paid for ten hours at the rate of $1 per hour. This scheme worked well for a short time, but the efforts of the crews to finish in the shortest possible time resulted in careless drilling, especially in the rib holes, causing excessive overbreakage. Two ten-hour shifts eventually took the place of the bonus system. An average progress for the 1,100 ft. of tunnel below the shaft was 12.2 ft. per day.

No artificial ventilation was required, as the shaft, completed early in the progess of the tunnel, acted as a vent pipe. The crews were able to enter the heading 30 minutes after blasting.

TABLE I—DRILLING AND SHOOTING SCHEDULES FOR VARIOUS TUNNELING METHODS, DIVERSION TUNNEL

Scheme No.	Heading and Bench 1	2	3	4	Full Face 5
From Sta.	0+10	1+10	2+03	2+39	3+92
To Sta.	1+10	2+03	2+39	3+92	15+60
Drilling:					
No. Holes					
Cut	7	7	10	13	12
Reliever	6	6	6	6	8
Breakdown	4	4	4	6	5
Rib	12	12	9	8	18
Down (bench)	18	..	..	20	..
Lifter (bench)	..	11	15	..	..
Total	47	40	44	53	43
Length holes, ft.					
Heading cut	8	8	8	8	10–13
Heading others	7	7	8	3	8–12
Bench down	6	..	..	4	..
Bench lifter	..	12	12	..	..
Lin.ft. drilling per cu.yd. excav.	10.6	9.7	11.3	8.7	8.7
Advance ft. per round					
Heading	5	5	5	7	7.5–10.5
Bench	6	10	10	7	..
Shooting:					
Headings, delays					
Cuts	0	0	0	0	0*
Relievers	1	1	1	1	0
Breakdowns	2	2	2	2	1
Ribs	3	3	3	3	1–2
Benches (see Fig. 5)					
Explosives, lb. per cu.yd. excav.	7.2	6.1	7.7	5.2	5.2

* Shot independently.

TABLE II—DRILLING AND SHOOTING SCHEDULE, DIVERSION TUNNEL SHAFT

Method	Sinking	Sinking	Sinking	Sinking	Raising	Raising
From El.	957	935	924	918	770	787
To El.	935	924	918	827	787	827
No. Holes						
Cut	12	12	18	12	12	13
Buster	0	2	2	4	0	0
Reliever	8	6	6	6	4	8
Rib	16	14	14	8	12	12
Total	36	34	40	30	28	33
Depth holes, ft.	4	6	8	8–10	9	8–12
Depth draw	2.5	3	6	6–8	7	7–11
Dynamite, %	40	40	40	60	40	40–60
Explosives, lb. per c.y. excav.	4.6	3.6	3.2	3.2	2.9	5.0

Average explosives, 4 lb. per cu.yd. excav.

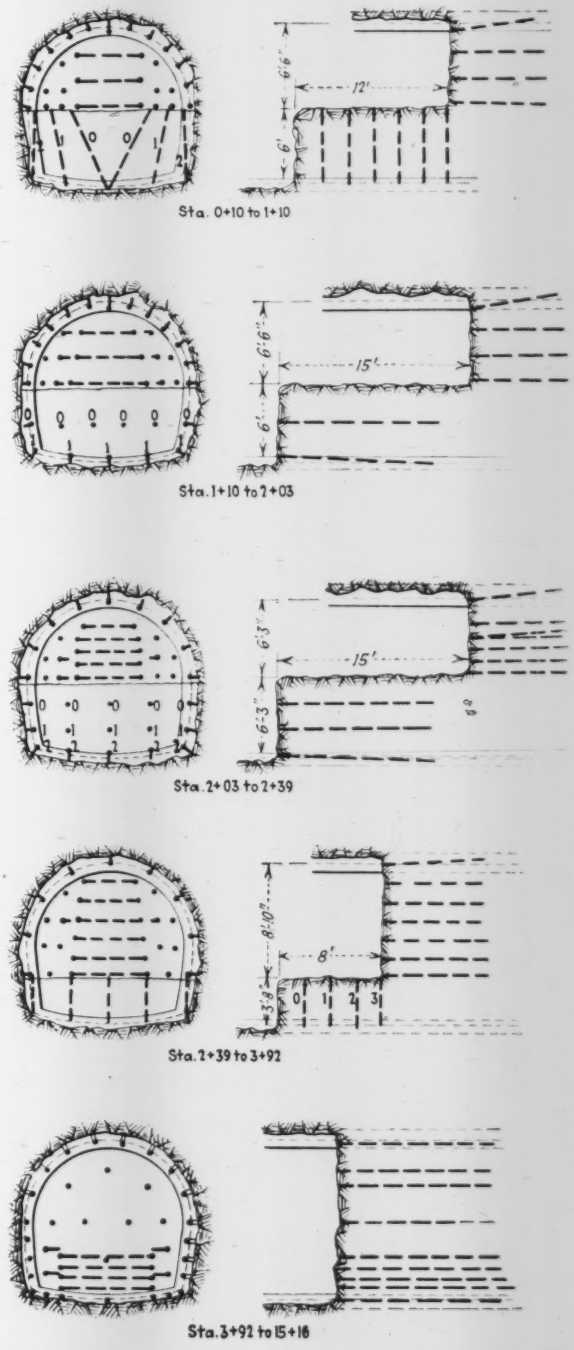


Fig. 4—Various heading and bench methods were tried in driving the diversion tunnel before full-face heading method (at bottom) was adopted as best. Figures on bench holes are exploder delays

One small air pump kept the headings dry. Only a few wet seams with a small amount of running water were encountered. The tunnel was driven down grade for its entire distance.

For about 200 ft. the headings and benches were drilled with jackhammers, the remainder of the tunnel being drilled with drifter drills mounted on columns. A working platform was used just above the springing line, four drifters being mounted below and two above the platform. Muck was loaded onto 1-yd. steel side-dump cars by small mucking machines and hauled to the outside by a gas locomotive.

Shaft Excavation—The shaft was sunk through solid rock from El. 957, 9 ft. below the surface, 130 ft. to El. 827. From the bottom up to El. 770 the shaft consists of the gate chamber. From El. 770 to El. 827, 57 ft., the shaft was excavated by the raising method. Jackhammers were used for sinking and stopers for raising the shaft.

The drilling and shooting methods for the shaft are given in Table II. An average of 4 lb. of explosives per cubic yard of rock was required for the entire shaft. Usually the shots were made in three volleys, the first consisting of cut and buster or sump holes, the second including the relievers and the third the rib holes. Sometimes the sumps were shot first and mucked out, then the other holes were loaded and shot. In sinking the shaft the muck was loaded by hand into a 1-yd. bucket, which was raised to the surface by a derrick. The muck from the excavation of raising the shaft was handled in the same manner as tunnel muck.

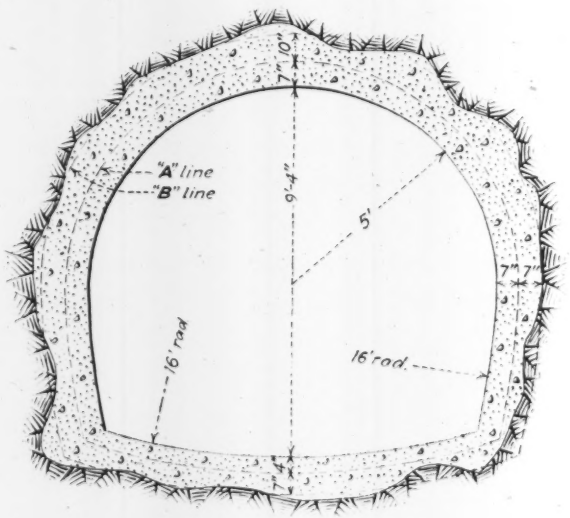
Pressure Shaft and Tunnel—The shaft for the pressure tunnel was sunk through solid rock, except for 14 ft. of earth cover the top. The shooting schedule consisted of 24 sump holes and 84 other down holes, drilled from 6 to 8 ft. deep with jackhammers. The position of the sump holes was shifted from one side of the shaft to the other each round. About 2 lb. of 40 per cent special gelatin dynamite was used per cubic yard of excavation. The sump holes were shot direct, the others in delays, as many as five being used. Muck was loaded by hand into a 1-yd. bucket and hoisted to the surface by a gasoline crane. A general progress of 1.3 ft. per day was made in sinking the shaft, which ran about 31 cu.yd. of excavation per foot of depth.

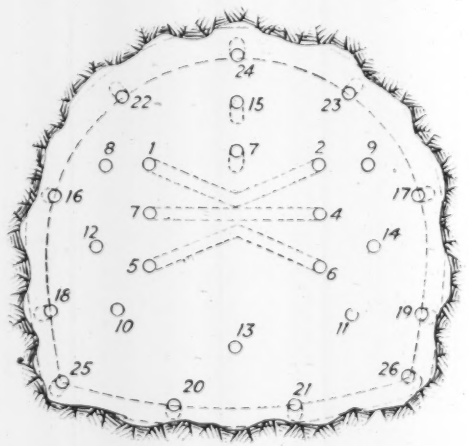
The top section of the shaft, through earth, was protected with 12-in. timber cribbing. Upon completion of the shaft a head frame and guide were built, and a one-car cage installed for hoisting tunnel muck to the surface.

Tunnel driving was carried on from both ends. At the east portal about 90 ft. of soft ground was encountered requiring timbering. The remainder of this tunnel was through solid rock, mostly mica schist with intermittent narrow veins of gneiss. Occasionally veins of Williamsburg granite were found. The mica schist and gneiss proved to be easy drilling, but shot very hard. It was sometimes necessary to shoot the cuts three times in these materials. The Williamsburg granite drilled hard, but shot easily. The entire tunnel was driven with a full-face heading (Fig. 5). Immediately after shooting, a crossbar was set up in the top of the heading, carrying three drifters. The upper half of the heading was drilled with the crew standing on the muck pile though mucking out started with the drilling. The remaining holes were drilled as soon as the mucking was completed.

The total number of holes in the heading varied from 25 to 32, although most of the tunnel was driven with 26 holes, consisting of seven cuts, eight relievers and eleven ribs, as shown in Fig. 5. The cut holes averaged 10 ft. long, the others 8 ft. Forty and 60 per cent special gelatin dynamite was used with direct and five-period delay exploders. The average draw was 7 ft. per round; the average dynamite consumed, exclusive of trimming, was about 7 lb. per cubic yard of excavation. A steady daily progress of 12.3 ft. at the east heading and 10.4 ft. at the west heading was maintained. The drilling crews did the loading and shooting.

Electric mucking machines were used at both headings, loading into 1-yd. wooden end-dump cars. At the east heading the muck was hauled out in four- to six-car trains with an electric dinkey. This muck was used in





Depth of holes 1-7 inclusive = 10 ft. ±
8-26 " = 8 ft.
Loading 1-7 " = 12.5 lb. 60% special gelatin
8-26 " = 6.3 lb. " " "
Firing order 1-7 inclusive, shot twice, direct each time
8-11 " first delay
12-15 " second delay
16-19 " third delay
20-23 " fourth delay
24-26 " fifth delay
Average distance pulled per round = 6.6 ft.
Average volume pulled per round = 29.7 cu. yd.
Average dynamite per round = 207.2 lb.
Average dynamite per cu. yd. rock = 7.0 lb.

Fig. 5—Shooting diagram of full-face heading method used in driving pressure tunnel. Dimensions of tunnel are shown in upper sketch

building 1,200 ft. of road near the portal. At the west heading the muck cars were hauled out one at a time to the bottom of the shaft by mules.

Little trouble was encountered with water. The west heading, driven entirely down grade, one small air piston pump was used near the heading, pumping the water to an electric centrifugal pump at the bottom of a shaft.

Ventilation was supplied by four blowers pumping air through 12-in. canvas ventilating tubes. After shooting the cut holes, but ten minutes was required for ventilation before the crew could re-enter the tunnel; but 1½ hours was allowed for ventilation after shooting the main heading.

Two 11½-hour shifts per day were used. The job was scheduled for 400 ft. of tunnel per heading each month. The contractor established the following bonus system for drilling and mucking services: For every foot of progress made over a specified distance per week the foreman received a bonus of $1; drillers and mucking machine operators, 70c.; the remainder of the crew, 35c. At the east portal the specified distance was 98 ft. per seven-day week during the first 2,300 ft. of tunnel, 91 ft. for the next 1,600 ft. and 84 ft. for the remaining 564 ft.

Great care was exercised in locating, drilling and shooting the rib holes to avoid overbreakage. Considerable time was spent on trimming, at an average cost of 13c. per square foot of area or $5.10 per foot of tunnel. As the tunnel excavation per foot was 4.5 cu.yd. at $10 per yard, the trimming cost was more than 13 per cent of the total excavation. The average excavated section was 1½ in. inside the payment line, making the value of saved excavation and concrete exactly equal to the cost of trimming.

This experience showed the wisdom of making a special effort to keep the tunnel section within the payment line. A tunnel driven consistently large in order to avoid the trimming later on, will prove expensive in extra excavation and additional concrete to replace the overbreakage. Again, in a tunnel driven too tight the trimming cost will offset any expected economy in rock excavation and concreting.

Two electric drive air compressors both located at the east portal, supplied air for the entire tunnel. Air was taken to the west heading through a pipe line 10,000 ft. long, ranging in diameter from 2 to 8 in. The pipe line was buried about 3 ft. because of extreme cold weather prevailing in the winter time. Constant fires were kept during the cold weather under exposed drainage points at each of 25 sags in the pipe line.

The drilling and trimming crews in the first shift consisted of one foreman, three drillers and three helpers. Mucking crews consisted of one machine operator and four muckers at each heading, with three trainmen at the east heading and seven mule skinners, dumpmen and hoistmen at the west heading.

During January, 1929, when the east heading had advanced 2,000 ft., a close observation or performance of the tunnel crew for several days revealed the following time schedule for various operations: actual drilling done during 11½-hour shifts, eight hours and seven minutes; speed in drilling, 29 ft. per drill per hour; load 26 holes in heading and shoot the cuts, 48 minutes; reload the cuts, wire and shoot the heading, 38 minutes; load 1-yd. car by mucking machine, three minutes; switch three cars by five men, four minutes; dump one car by two men, 1½ minutes; lay one 15-ft. section of track by five men, 50 minutes; mucking machine idle between loading successive cars, four minutes. The work was shut down 10 per cent of the time due to breakdowns and repairs of equipment.

Results of a careful analysis of the actual cost of excavation, made in January, 1929, without allowing any overhead or profit to the contractor, are given in Table III.

TABLE III—ACTUAL COST PER CU.YD. EXCAVATION, PRESSURE TUNNEL

	Tunnel		Shaft	
	Cost	Per Cent	Cost	Per Cent
Labor	$6.43	69.6	$6.21	71.6
Explosives	1.09	11.8	.55	6.3
Power	.49	5.4	.37	4.3
Fuel	.07	.7	.19	2.2
Equipment	1.16	12.5	1.35	15.6
Total	9.24	100.0	8.67	100.0

Wage rates per hour: foreman, $1.10; hoist runner, $1; drillers, 70c.; mucking machine operators, 75c.; dinkey skinners, 60c.; laborers, 50c.; blacksmith, 90c.; helper, 60c.; compressor operator, 70c.; carpenter, $1.

TABLE IV—COST OF DIVERSION TUNNEL

Item	Quan.	Unit Price	Amount
Excav., open cut, cu.yd.	902	$10	$9,024
Excav., tunnel, cu.yd.	10,289	19	195,482
Excav., shaft, cu.yd.	1,289	19	24,491
Concrete, tunnel, cu.yd.	3,421	20	68,410
Concrete, shaft, cu.yd.	590	20	11,800
Concrete, portals, cu.yd.	122	25	3,043
Grouting, 417 holes		Extra	10,374
Temporary roads		Lump	5,000
Railing in shaft and other extras		Extra	1,953
Total cost			$329,577
Cost per ft. tunnel, excluding shaft			$182.48

TABLE V—COST OF PRESSURE TUNNEL

Item	Quan.	Unit	Amount
Tunnel:			
Excav., earth open cut, cu.yd.	7,742	2.00	$15,484
Excav., rock open cut, cu.yd.	8,520	5.00	42,600
Excav., Tunnel, cu.yd.	32,489	10.00	324,886
Timbering, ft.b.m.	14,662	50.00	733
Cleaning tunnel bottom			3,136
Grouting, holes	454	24.64	11,185
Concrete lining, cu.yd.	10,621	18.00	191,178
Bonus, per day	37	100.00	3,700
Total cost of tunnel			592,902
Cost of tunnel per lin.ft.			83.70
Shaft:			
Excav., earth open cut, cu.yd.	5,155	2.00	10,310
Excav., rock open cut, cu.yd.	178	5.00	890
Excav., rock shaft, cu.yd.	3,000	7.00	21,003
Concrete, cu.yd.	2,547	18.00	45,847
Reinforcing steel, lb.	44,309	.05	2,215
Structural steel, lb.	115,467	.924	10,662
Gate and appurtenances			25,113
Hand railing			117
Misc.			529
Total cost of shaft			$116,686
Gate house			14,734
Total cost pressure tunnel project			$724,322

Costs—Detailed costs of both tunnels are given in Tables IV and V. All extras are included, in addition to bid prices, to show total actual costs. The cost of engineering, division engineer's office only, amounted to about 5 per cent of total cost.

Personnel

The Cobble Mountain project is being built by the Springfield board of water commissioners, with E. E. Lochridge as chief engineer, Hazen & Everett, New York, as consulting engineers and the author as division engineer in charge of construction. The Frazier-Davis Construction Co., St. Louis, was contractor on the pressure tunnel work, with R. J. Burns as superintendent. Contract for the diversion tunnel and shaft was held by Coleman Bros., Inc., Boston, with C. J. Maney as superintendent.

NEWS OF THE WEEK

Contracts Awarded for Belt R.R. Bridge at New Orleans

Four major contracts covering the construction of the New Orleans Public Belt Railroad bridge across the Mississippi River at New Orleans, La., were announced on Sept. 19 as approved by the statewide advisory committee and Nov. 2 was set as the date for sale of $7,000,000 in state highway bonds representing the contribution of Louisiana to the cost of the structure. The successful bidders were:

Siems-Helmers, Inc., St. Paul, Minn., substructure for main span, $3,083,185; American Bridge Co., New York, superstructure of main span, $2,618,670; McDonald Engineering Co., Chicago, substructure approaches, $496,337; McClintic-Marshall Co., New York, superstructure of approaches, $3,226,789.

Bids to Be Called for Extension of Boston Airport

Mayor James M. Curley, of Boston, has announced that bids for the extension of the Boston airport will be opened Oct. 6. The improvements will cost $750,000. The proposed work includes 2,600,000 cu.yd. of fill, extensions and repairs to the bulkhead and construction of a hydroplane basin 4,000 ft. in circumference. The money for the project will be taken from the $1,250,000 voted by the city for the Governor's Island (Boston harbor) undertaking.

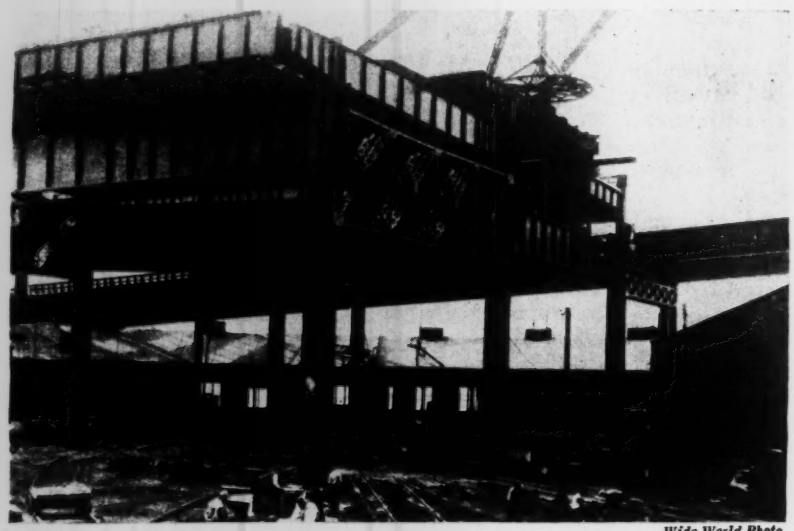
Western Pacific-Great Northern Cutoff to Open Nov. 2

The first freight train to run on the new Western Pacific-Great Northern cutoff between Klamath Falls, Ore., and Keddie will start on Nov. 2, one month ahead of the original schedule, it is announced by George Neubourg, superintendent of the Sacramento Northern Railroad. This $13,000,000 cutoff was not expected to be ready before Dec. 1.

Dotsero Cutoff Authorized by Commerce Commission

Construction of the Dotsero cutoff by the Denver & Salt Lake Western Railroad was formally authorized by the Interstate Commerce Commission on Sept. 17. The Denver & Rio Grande Western Railroad likewise was granted authority to acquire control of the Denver & Salt Lake Railway, of which the Denver & Salt Lake Western is a subsidiary. The commission's action was taken with the understanding that the Denver & Rio Grande Western would file application for permission to operate over the proposed cutoff and the Moffat line.

Work on the cutoff, to cost $3,000,000, must begin not later than March 15, 1932, according to the ruling, and be completed by September, 1933. Construction bids will be asked about Oct. 1, it was indicated at D.&R.G.W. headquarters in Denver.



Wide World Photo

PROGRESS ON NEW YORK'S ELEVATED HIGHWAY

This section of the west side express highway, now under construction from 59th St. north to 72d St., New York City, was built over the New York Central freight yards and roundhouse from West 66th St. to West 71st St. without interruption of railroad traffic. The photograph shows the express highway as it is being constructed over the railroad at West 71st St.

Changes in Jadwin Flood-Control Plan Demanded

Major changes in the Jadwin plan for the control of flood in the lower Mississippi Valley were demanded by the Mississippi River Flood Control Association at a meeting held recently in Memphis, Tenn. A committee to draft proposed legislation was appointed and the support of many congressmen was pledged.

The association asks compensation for landholders damaged in levee setbacks, full protection of backwater areas, reservoirs on the tributary streams and narrowing of floodways now proposed under the Jadwin plan.

Harry Jacobs, chief engineer of the Louisiana state board of engineers, outlined a flood-control plan, known as the Louisiana plan, which includes $242,000,000 for the construction of reservoirs in the White and Arkansas rivers. The total cost of the plan is placed at $664,750,000.

Pay Reductions Announced by Large Industrial Firms

Five of the country's largest corporations in three major industries have recently announced drastic cuts in salaries or wage rates. Wages of workers employed by the U. S. Steel Corp., the Bethlehem Steel Corp. and the Youngstown Sheet & Tube Corp. will be cut 10 per cent on Oct. 1. The General Motors Corp. has given notice of a 10 to 20 per cent salary reduction which will affect about 25 per cent of its 172,000 employees. A five-day working week will be put into effect on Oct. 1 by the U. S. Rubber Co.

Scrip-Labor Unemployment Relief Applied in Grand Rapids

Relief of distress resulting from unemployment is being obtained by "giving away work" instead of charity in Grand Rapids, Mich. Representatives of families in need of assistance are employed by the city on public improvement work, for which they are paid in scrip redeemable for the necessities of life only at city-operated stores. An emergency bond issue finances the work.

The plan was first put into operation in a small way in December, 1929, by employing men for removing snow and ice from the city streets. Since then the organization has developed so as to include work for many city departments. A man from the city engineer's office has been assigned the full-time task of discovering suitable work to do. Such jobs as cleaning up a river bottom, con-

structing a new outdoor swimming pool, razing an old city-owned building to prepare for a major improvement and laying a 30-in. pipe line to extend the sludge discharge from the water-purification plant have been carried out.

At the beginning of this month, according to the city manager, George W. Welsh, 3,294 families were being cared for in this way, accounting for more than 80 per cent of the total amount spent for relief purposes. The remaining 20 per cent is used for direct charity in those cases where there is no able-bodied man capable of working. All the men are paid at the same rate, 40c. per hour, but the kind of work to which any one is assigned depends upon the recommendation of a medical examiner. The number of hours' work allotted to each man is governed by the size of his family. Single men get but little work. Most of them are cared for in the city's social center. Applicants for relief have their needs investigated by the city welfare department, which insists that other sources of financial support, such as savings accounts, must be exhausted before work by the city is supplied.

Pay is not in money but in scrip. The only place the scrip can be redeemed is at stores operated by the city where only food and clothing are on sale. The certificates of payment are not transferable, each coupon bearing a serial number which must be checked against an identification card required to be carried by the worker.

A Plan to Stabilize Industry

Gerard Swope proposes compulsory trade association membership and transferable worker insurance

ADDRESSING the National Electrical Manufacturers Association at its New York meeting on Sept. 16 under the title "Stabilization of Industry," Gerard Swope, president of the General Electric Co., proposed a remarkable plan. It is directed toward stabilizing employment by making industrial operations less subject to fluctuation and by providing for the worker a system of protective benefits "accruing through the life of the worker and following him where he might go, from shop to shop within a particular industry, or from branch to branch within industry as a whole." The motive back of the proposal is the author's conviction that "industry must evolve and make effective those measures which will first ameliorate and ultimately eliminate" unemployment, and that "industry must do this thing, because it will surely be done."

Two Steps Proposed

To stabilize the commercial operations of industry, Mr. Swope proposes (1) standardized forms of corporation reports for the better information of stockholders, and (2) a means of coordinating production and consumption without destroying individual originality, initiative and enterprise. For the latter purpose he proposes that in any given industry all companies over a certain minimum size shall join in a trade association under the supervision of the Federal Trade Commission or some other federal body. Such associations are to adopt and apply the protective benefit systems for the workers described below. In addition they "may outline trade practices, business ethics, methods of standard accounting and cost practice, standard forms of balance sheet and earnings statement, etc., and may collect and distribute information on volume of business transacted, inventories and merchandise on hand, simplification and standardization of products, stabilization of prices, and all matters which may . . . promote stabilization of employment and give the best service to the public." The administrative board of the trade association is to comprise three members appointed by the association, three by the employees of the member companies, and three by the federal supervisory body, but this board is to control only the worker benefit relations, while the trade relations are to be supervised by the federal supervisory body directly. Legislation to make this plan possible would probably include modification of the anti-trust laws.

Protection for Workers

Protection for the workers is to comprise workmen's compensation, life and disability insurance, a pension system and unemployment insurance. All except the workmen's compensation are to be contributory, the worker and the company making equal payments to the respective funds. The protection is to be so administered as to continue when an employee leaves one company and goes to another.

As to life and disability insurance Mr. Swope suggests a policy approximately equal to one year's pay, but not more than $5,000, any excess being carried at the cost of the employee. Employees taking the insurance when more than thirty-five years old are to pay the excess premium for age over 35, a provision intended to remove the necessity of restriction against engaging employees because of advanced age. The pension plan contemplates payments by both employee and company, each amounting to one per cent of earnings but not more than $50 per year (with adjustment for entering age over 35); the funds so collected are to be administered by a pension trust operated by the trade association (in no case by the individual company), and the accumulated credit shall be transferred when an employee goes to another company in the same or another trade association. When he goes to a company not a member of a trade association or goes into business for himself the amount of his own payments with interest shall be given to him. The pension fund is expected, when compounded semi-annually at 5 per cent until retirement at age 70, to provide an annuity of approximately half pay.

Employer and Worker to Contribute to Unemployment Fund

Unemployment insurance funds are to to be accumulated from payments of 1 per cent of earnings but not more than $50 per year by both company and worker, except that the payment need not be made if the company guarantees employment for at least 50 per cent of the normal wage paid each year. The company payment may also be discontinued when its accumulated payments amount to 5 per cent of the normal annual earnings of the employees. In an unemployment emergency, normal payments by both companies and employees cease, after which all employees receiving 50 per cent or more of average full-time earnings shall pay 1 per cent of current earnings into the fund, the company to pay a similar amount.

Payments During Unemployment

Payments from the unemployment fund shall amount to about 50 per cent of the employee's average full-time earnings, but not more than $20 per week, and shall begin after the first two weeks of unemployment and continue for not longer than ten weeks in any twelve consecutive months. Payments may also be made when part time earnings are less than 50 per cent of full-time earnings. Relief and loan payments may also be made from the fund. The employee's credit in the unemployment insurance fund is to be transferred to the new company when he changes employment, the company's share being paid back by the trade association to the company which he has left.

Summary by Mr. Swope

Mr. Swope concluded: "The foregoing plan tends to put all domestic corporations of the class described on a parity for domestic business, thereby removing the inequalities of the different laws in the several states, provides for standard forms of financial reports and their periodical issuance for the information of stockholders, places on organized industry the obligation of coordinating production and consumption, and of higher degree of stabilization. This will tend to assure more uniform and continuous employment for the worker and to remove fear from his mind, allowing him to devote himself whole-heartedly to his task. Cost of the product will include these items and will therefore be paid for by the users of the article or service and not in general by members of the community reached by the vicarious method of the imposition of a tax. Then organized industry will be in a position that it should rightly assume of serving the public, with public confidence and with the joint participation of workmen and management in the solution of these vital and far-reaching problems."

Welding Society Receives Report of Structural Committee

At fall meeting in Boston, five-year research program is brought to end with announcement that a new investigation is being planned

Engineering News-Record Staff Report

THE annual fall meeting of the American Welding Society being held in Boston this week in conjunction with the National Metal Exposition and the National Metal Congress devoted the sessions of the first two days to structural subjects, notably presentation of the report of the completed investigation of the structural steel welding committee. Two papers were also given that described current structural welding work. The technical seasons will continue throughout the week, but the principal items of structural interest have been disposed of.

One important committee was appointed, and O. E. Hovey, consulting engineer, American Bridge Co., was elected a member of the executive committee at a meeting of the board of directors. To the new committee is delegated the task of planning a future series of structural welding investigations that will supplement the present report. An unexpended balance of about $8,000 is available for the work. The members of the committee are Frank P. McKibben, H. H. Moss and O. E. Hovey.

Structural Welding Report

In presenting the report of the structural steel welding committee, Leon S. Moisseiff, chairman, paid tribute to the late James H. Edwards and his work in organizing the investigation and carrying it through to near completion. W. Spraragen, secretary of the American Welding Society, reviewed the plan under which the committee was organized and pointed out how the financial support had come from the American Institute of Steel Construction ($10,000), the National Electrical Manufacturers Association ($7,500) and associated groups in the gas-welding field ($5,000). Of this total of $22,500, about $8,000 is available for further research work. H. M. Priest, vice-chairman of the committee, reviewed the results of the report in detail. A similar review by Mr. Priest appeared in last week's *Engineering News-Record*. In discussion Mr. Spraragen and others voiced the opinion that the byproducts of the investigation, particularly in acquainting many fabricators with welding research, would prove as important as the direct test results. F. T. Llewellyn (U. S. Steel Corp.), who was intimately connected with all phases of the investigation, including the editorial preparation of the report, urged that the result be studied independent of the committee's conclusions. All of the data are given so that this opportunity is afforded everyone who secures a copy of the report. Prof. Comfort A. Adams remarked on the necessity for extending the investigation to include covered electrodes and perhaps alternating current; he visioned greatly increased ductility of the weld metal and consequent higher working stresses in the future.

Technical Papers

Two papers on structural welding were given by Frank P. McKibben and Gilbert D. Fish respectively. Prof. McKibben discussed the Du Pont office building in Wilmington, Del., which formed the subject of an article by him in *Engineering News-Record*, Sept. 3, 1931, p. 374. In addition to describing the use of the truss over the lobby to pick up the load (through a welded joint) of a column whose lower portion was removed, which formed the subject of the above-mentioned article, Prof. McKibben also included in his paper discussion of a similar operation involving a plate girder over a driveway that entered the building. The column load was transferred to the girder by means of a hydraulic jack setup, the girder being deflected a predetermined amount before the welded connection was made.

Four completely arc-welded buildings being built at Yale University, New Haven, Conn., were described by Gilbert D. Fish. Briton-Hadden Hall, a small four-story bearing-wall structure and the new administration building for the Sheffield scientific school, the latter involving about 800 tons of steel, are nearly erected. Steel is being fabricated for a new dormitory quadrangle involving 940 tons and for the Sarah Wey Tompkins Memorial, a six-story flat-roof structure which will require 560 tons of steel. Of the four buildings, the administration and dormitory structures are the most interesting, both being highly irregular in plan and surmounted by complicated gable roofs. The administration building is of Gothic-type architecture five stories high with an 11-story tower. The dormitory varies from four to seven stories in height. In the variety and actual number of welded connections these structures set a high mark. There are 10,000 separate beams in these structures and literally thousands of joints, ranging in working capacity from 6,000 to 250,000 lb. Eccentric conditions are the rule. All columns and most of the beams and roof members required individual shop drawings. The designs as worked out showed 2½ per cent of the steel in the connections as compared with about 5 per cent in a riveted job. Expressing all sizes of welds in terms of their volume equivalent in ⅜-in. fillet welding, the average for these buildings is about 8 ft. of shop welding and 4 ft. of field welding per ton of steel.

In so far as the structural design of these structures is concerned most beam-to-column connections included beam seats shop welded to the columns. Often these seats carried the entire load, without aid from a web connection. When connections were made by welding beam webs directly to column flanges care was exercised to make the joint strong enough that any bending would occur in the beam alone. Inasmuch as most beam connections were of the flush-top type it was possible to shop weld projecting plates on the top flange and utilize these as erection connections, merely hanging the beam from its girder support by these plates.

Information furnished bidders on these jobs included detail drawings of all typical and many special connections, as well as weight of connection material and quantities of shop and field welding required. Mr. Fish believes that such procedure tends to insure lower bids and to foster more businesslike estimating on the part of the bidders.

A final interesting feature of these buildings is the system used for guiding the detailers in making shop drawings and for indicating locations of field welds. Large-scale drawings were made for every joint design used and a serial number assigned to each. On the framing plans only these serial numbers appeared at the intersections of the members, thus greatly simplifying the job blueprints. "The work of detailing welded buildings appears to be no more exacting or difficult than the corresponding work on riveted construction, but it is certainly not much if any easier," said Mr. Fish. Any saving from the elimination of dimensioning rivet holes is offset by the need for specifying sizes and lengths of welds. There is also a greater variety of connections in a welded job than in a riveted one. Mr. Fish stated that there is need for comprehensive classification of welded joint designs for ready reference and for reduction of drafting-room labor.

Santa Monica Voters Approve Bonds for Breakwater

A proposed bond issue of $690,000 for the construction of a municipal yacht harbor and breakwater was approved on Sept. 11 by the voters of Santa Monica, Calif., by a vote of 5,425 for and 1,925 against. Plans call for a harbor to accommodate a minimum of 400 pleasure boats. A breakwater, open at both ends, will extend from 200 ft. south of the present municipal pier to a point 1,800 ft. north of the pier. A suspension bridge will be built between the pier and the breakwater. Howard Carter, city engineer, announces that work will be started immediately.

New Bridge in New Zealand

The New Zealand government has approved a plan for the erection of a new bridge over Auckland harbor, and work is to be commenced early next year. The work will be undertaken by the British firm of Dorman Long & Co., which recently constructed the Sydney harbor bridge, and will provide employment for about 700 men for 2½ years.

Sanitary Engineers and Public Health Association Meet

OVERLAPPING and partly joint meetings of the Conference of State Sanitary Engineers and the American Public Health Association, held at Montreal last week, dealt with many problems of current importance in sanitation. One of the most timely items was consideration of the feasibility of relieving unemployment by promoting installation of needed sanitary engineering works. A number of state sanitary engineers reported effort and progress in this direction, and a committee report by W. L. Stevenson recommended that state sanitary engineers make surveys of "needed sanitary work in order to consummate such public health projects as will give useful work to the unemployed." This report was indorsed by the public health engineering section and by the governing council of American Public Health Association.

In the field of water supply the most notable contribution to the conference was a census of water-purification plants by a committee headed by H. W. Streeter. It showed that 34,000,000 persons in the United States are provided with water from purification systems and about 23,000,000 with water that is chlorinated only. Altogether 57,000,000, or 83 per cent of the urban population, are provided with treated water by nearly 3,000 plants.

Malaria and Mosquito Control

Revived interest on the part of engineers in malaria control and mosquito eradication was evidenced by extended discussion of an address by Dr. L. L. Williams, in charge of malaria investigations for the U. S. Public Health Service. He described the latest developments in the technique of mosquito eradication.

In a symposium on drought, E. S. Tisdale (West Virginia) dealt comprehensively with the effects of the recent drought in the five states most affected. Limitations of available methods of water purification were emphasized in coping with heavy pollution resulting from drought. Dr. W. V. Veldee (U. S. Public Health Service) read a significant paper entitled "An Epidemiological Study of Suspected Waterborne Enteritis," which demonstrated that a severe intestinal disorder which started at Charleston, W. Va., and later extended to cities along the Kanawha and Ohio rivers was due to public water supplies notwithstanding the fact that these supplies met all analytical and physical standards of purity with the exception (in some cases) of taste and odor. While the symptoms of the disease suggested an organism infection, the weight of all the evidence indicated the presence of toxic chemical decomposition products as the cause.

The experience described by Dr. Veldee was commented on as casting doubt on F. T. Goudy's assertion (*ENR*, March 12, 1931) that the purification of domestic sewage for reuse as domestic water supply is an attainable and desirable goal. The experience also calls attention rather sharply to the fact that we have no reliable measure of permissible limits of pollution with which available methods of water purification can cope. An interesting deduction from the papers of Mr. Tisdale and Dr. Veldee is that while the raw water pollution which caused at least 9,000 cases in Charleston in late October and early November was so intense as to leave the raw water devoid of oxygen, the raw water pollution which caused many cases during January in Huntington, Ashland, Suterville, Trenton, Cincinnati and Louisville was far less intense.

Drought and Sewage Disposal

In "Sewage-Disposal Difficulties During Drought," L. S. Finch (Indiana) enumerated and described the many effects of drought on sewage-treatment works and on streams receiving sewage and treatment plant effluents. While the general effect of drought is to make inoffensive sewage disposal more difficult, it acts in many cases to bring about self-purification of streams in a shorter distance due to retarded velocity of flow.

In the light of Dr. Veldee's paper and in view of known toxic effects of decomposition products on fish, as discussed by L. F. Warrick (Wisconsin), the apparently improved self-purification of streams during drought may actually result in greater danger to human health (through water supplies) and to fish life than in periods of normal rainfall.

C. H. Spaulding (Springfield, Ill.) presented an important paper on contamination of water mains by jute packing. He described how jute becomes contaminated as a result of insanitary methods used in its preparation and showed by the results of experiments that the jute used in making cast-iron pipe joints may greatly increase the content of *B. coli aerogenes*. He pointed out that sterilized jute is available on the market and he recommended its use.

H. W. Van Hovenberg made a strong plea for use of trained sanitary engineers in county public health work to replace so-called sanitary inspectors. He advocated calling these engineers "sanitary officers" and placing them on an equal basis with county medical officers. Mr. Van Hovenberg's suggestions were indorsed in a general way by Dr. W. F. Draper, commissioner of health of Virginia.

C. J. Des Baillets, chief engineer of the Montreal waterworks, gave a general history and description of the water supply of Montreal. The use of reinforced-concrete distribution mains and architectural treatment of pumping stations gave rise to interested comment.

A committee on sewage disposal headed by Langdon Pearse presented an elaborate report with bibliography on experience with oils, greases and gasoline in sewers and sewage-treatment works.

Louis Cantor, chief sanitary engineer of the Palestine department of public health, gave an interesting account of the transformation that American methods of sanitation are bringing about in the Holy Land.

Officers Elected

Among the officers elected for 1931-32 were John A. Ferrell, M.D. (New York City), president, and Robert Spurr Weston (Boston), second vice-president, A.P.H.A.; George W. Putnam (Chicago), chairman, and Arthur D. Miller (U.S.P.H.S., Washington), secretary, public health engineering section, A.P.H.A.; Earnest Boyce (Lawrence, Kan.), chairman, Conference State Sanitary Engineers.

COSTS AND CONTRACTS

ENR Index Numbers

Cost			Volume		
Sept. 1,	**1931**	**171.40**	**August,**	**1931**	**187**
Aug. 1,	1931	171.38	July,	1931	248
Sept. 1	1930	199.58	August,	1930	259
Average,	1930	202.85	Average,	1930	260
Average,	1929	207.02	Average,	1929	317
1913	.....	**100.00**	**1913**	.....	**100**

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Sept. 24, with some comparisons, total as follows:

(In Thousands of Dollars)

	Sept. 24, 1931	Average of Last Four Weeks 1931	1931
Buildings:			
Industrial	$3,541	$2,505	$4,410
Other	11,028	12,984	23,093
Streets and roads.	7,798	7,460	10,395
Other construction	17,349	21,642	15,650
Total	$39,716	$44,591	$53,550
Total, all classes, Jan. 1 to Sept. 24:			
1931			$1,966,524
1930			2,568,172

Bond to Be Required of New Jersey Highway Subcontractors

Contractors on state highway work in New Jersey have been informed by the state highway commission that they must require a bond from their proposed subcontractors and that evidence of the existence of such bonds must be furnished to the state highway engineer with the request for approval of a subcontractor.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded in the United States during the month of August, divided according to roads, streets and alleys, and the totals for the eight months' period ended Sept. 1:

	During August	To Aug. 29
Roads	5,437,434	95,414,767
Streets	2,146,335	16,033,713
Alleys	90,930	603,820
Total	7,674,699	112,052,300

Hoover Dam Notes

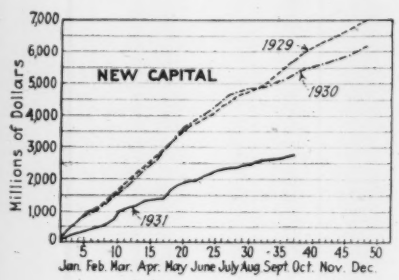
Greatly increased efficiency on the part of labor is reported from Hoover Dam as a result of cooler weather, better housing and improved living conditions. As a consequence labor turnover was small during the week ended Sept. 12, and much greater contentment among the employees is in evidence.

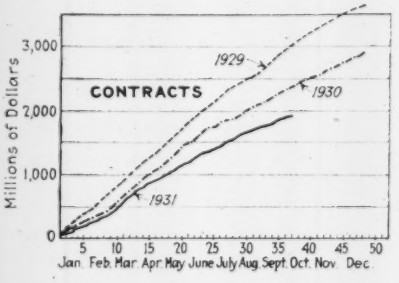
During the week a fall of rock in the inner Arizona tunnel caused the death of one worker and injury to two others. Pioneer headings were started on the outer tunnels on both sides of the river. All the pioneer headings, excluding adits, totaled 3,755 ft. to Sept. 12, a total progress of 635 ft. for the week. Totals of each tunnel are: outer Nevada, three headings, 45 ft.; inner Nevada, four headings, 1,634 ft.; inner Arizona, three headings, 55 ft.

The employment office has been moved to Las Vegas. It has been found that the trip from Las Vegas to the government reservation causes unnecessary hardship to applicants for jobs. Moreover, the location of the federal employment office at the entrance of the reservation has resulted in congestion. All labor engaged on the work is recruited exclusively through the federal employment office.

Capital and Contracts

New capital issued in the week of Sept. 19 totaled 78 millions—60 public and 18 private. This week's total makes a considerably better showing than that of the same week in August, which was 57 millions. It is 7 per cent below the average week in September, 1930, which was 84 millions.





The three largest bond issues of the week were: State of New York 3s, $40,000,000; Louisville & Nashville Railroad Co. 5s, $10,000,000; city of Baltimore 4s, $6,827,000.

Cumulatively, the capital issued between Jan. 1 and Sept. 19 amounts to 2,814 millions, compared with 5,116 millions in the corresponding part of 1930, a drop of 45 per cent. Contract lettings fell 23.8 per cent in the same period this year compared with last.

Personal Notes

WILHELM D. STYER, major, Corps of Engineers, has arrived in Pittsburgh to assume his duties as district engineer.

THOMAS B. DEMPSEY, formerly with the Randolph-Perkins Co., is now assistant engineer and designer with the board of local improvements, city of Chicago.

Obituary

JOHN E. NELSON, a partner in the contracting firm of J. E. Nelson & Sons, Chicago, died Sept. 5. He was born in 1881 and after early experience in building work was superintendent on several jobs of railroad construction. In 1909 he was made a partner in the firm established by his father.

WILSON LEVERING SMITH, 53 years of age, of Baltimore, died suddenly in his office on Sept. 15 of heart disease. Mr. Smith was a member of the architectural firm of Smith & May, which designed many buildings in the city and state. After being graduated from Johns Hopkins University in 1900, Mr. Smith studied architecture at Columbia University and later spent a year in European study and travel. He first joined the architectural firm of Parker, Thomas & Rice but resigned in 1912 to form the firm of Smith & May with Howard May.

WILLIAM JOSIAH VOTEY, dean of the college of engineering at the University of Vermont, died in Burlington, Vt., on Sept. 16. He was 71 years old. Prof. Votey was graduated from the University of Vermont in 1884 and in the same year became instructor of civil engineering at that institution. He was made assistant professor in 1889 and professor in 1893. He became dean in 1901. Prof. Votey served on the Vermont state highway commission from 1892 to 1896, and since 1908 he had been sanitary engineer of the state board of health. He devoted much of his time in late years to a study of Vermont floods, gathering data on high water in various communities as far back as 1789.

SOCIETY CALENDAR

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual convention, Huntington, W. Va., Sept. 28-30.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington; annual meeting, Sept. 28-Oct. 1, Salt Lake City.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; fall meeting, St. Paul, Minn., Oct. 7-9.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, St. Louis; meeting, Oct. 19-26, Pittsburgh.

ASSOCIATION OF WESTERN STATE ENGINEERS, fourth annual conference, Sacramento, Calif., Oct. 28-30.

INTERNATIONAL CITY MANAGERS ASSOCIATION, Chicago; annual meeting, Oct. 7-10, Louisville, Ky.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Chicago; conference, Sept. 24-26, New York City.

NATIONAL MUNICIPAL LEAGUE, New York City; annual meeting, Nov. 9-11, Buffalo, N. Y.

NATIONAL SAFETY COUNCIL, New York City; twentieth annual safety congress, Chicago, Oct. 12-16.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; annual convention, Sept. 29-Oct. 2, Boston.

AMERICAN SOCIETY OF SANITARY ENGINEERS at its 26th annual convention in Richmond, Va., Sept. 10-11 elected officers as follows: president, Thomas M. Dugan, McKeesport, Pa.; vice-presidents, George Stolz, Milwaukee, Wis.; William D. Borbro, San Francisco, Calif.; Luke J. Devine, Elizabeth, N. J.; A. D. Chandler, Fort Worth, Tex.; James Smith, Winnipeg, Manitoba; W. H. Meadows, Toronto; Thomas J. Manahan, St. Louis; treasurer, J. F. Doud, Cincinnati. The secretary will be appointed by the president.

ENGINEERS CLUB OF CINCINNATI has elected officers as follows: president, Bruce G. Maxon, consulting engineer; vice-president, C. A. Joerger; secretary (re-elected), E. A. Gast, 27 West Ninth St., Cincinnati, Ohio.

ENGINEERS SOCIETY OF MILWAUKEE has announced the following nominations for 1931-32: president, Harry Sloan; vice-president, Fraser Jeffrey; treasurer, Walter R. Mueller; secretary, Hugo W. Rohde. The election will be held at the annual meeting on Oct. 21.

NEW ENGLAND SEWAGE WORKS ASSOCIATION will hold its fall meeting in Providence, R. I., on Oct. 10. The technical session will be devoted to papers on sewer maintenance, sand filtration, and the new Providence sewage-treatment plant.

NEW JERSEY PUBLIC HEALTH AND SANITARY ASSOCIATION will hold its annual meeting on Oct. 1 at the New Jersey Agricultural Experiment Station, New Brunswick. Stream pollution and sewage treatment, with special reference to the Raritan Valley, will be discussed in papers by Willem Rudolfs, chief of sewage investigation, New Jersey Agricultural Experiment Station, and W. DeWitt Vosbury, sanitary engineer, Camden.

NEW YORK STATE SEWAGE WORKS ASSOCIATION will hold its fall meeting in Ithaca Oct. 16-17. Following a brief business meeting there will be a symposium on the various aspects of stream pollution that may affect public water supplies and fish life.

ROCKY MOUNTAIN SECTION, American Water Works Association, announces an exhibition of waterworks materials or accessories at its fifth annual meeting in Denver, Col., Oct. 21-23. In connection with the meeting there will also be a two-day waterworks college sponsored by the extension division of the University of Colorado.

WASHINGTON STATE GOOD ROADS ASSOCIATION, recently convened at Centralia, Wash., elected the following officers for 1932: president, Fred W. Hastings, Seattle; vice-presidents Wesley Vandercook, Longview; S. J. Chadwick, Seattle; Julius S. Hubbell, Ellensburg; S. W. Fawley, Waterville; Herman Freese, Snohomish; treasurer, Arthur Lund, Tonasket. The 1932 convention will be held in Spokane.

WISCONSIN WELDING CONFERENCE will be held at the University of Wisconsin, Madison, Wis., Oct. 8-10. Arrangements and program in charge of J. M. Dorrans, Mechanical Engineering Building, University of Wisconsin.

CONSTRUCTION NEWS

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WATERWORKS

PROPOSED WORK

Ark., Morrilton—Arkansas Power & Light Co., Pine Bluff, preliminary plans 1,400 ft. 8 in. mains, laterals in Center and Childers Sts.; 8 in. main in Morrill St.; 6 in. mains in North Ave., Howard, Cherokee, Moose and Childers Sts., installing new deep wells or changing present purification system of river water; installing new 250,000 gal. reservoir, replacing all defective fire hydrants, installing sixty 250 cp. whiteway lamps.

Calif., Linden—Linden Irrigation Dist. irrigation works, incl. pumping plant, pipe lines. Election soon $93,000 for financing same. F. H. Tibbetts, Alaska Comm. Bldg., San Francisco, engr.

Calif., Santa Ana—Bd. Supervs. Orange Co. elevated steel tank, pumping equipment for new well in Westminster Dist.; also 17,000 ft. 2- to 4-in. c.i. pipe. W. K. Hillyard, Santa Ana, co. surv.

Ky., Ludlow—Waterworks improvements, extensions, incl. installing pumping machines, softening plant, main extensions. $120,000. Glazier & Morlidge, 305 Walnut St., Cincinnati, O., engrs.

Mass., Cambridge—See "Contracts Awarded."

Mass., Natick—Town, Bd. Selectmen, extending mains in Worcester St., et al. To exceed $15,000.

Mich., Pontiac—Extending main extensions, 5,030 ft. 6- to 12-in. c.i. mains in Huron St., from Williams to Monroe Sts., incl., 14 six in. hydrants, 19 six in., 4 eight in. and 13 twelve in. gate valves and boxes. J. R. Pollock, City Hall, engr.

Minn., Minneapolis—Commission of 3 consulting engineers appointed to survey report on waterworks recommended to City Water Com., incl. 16 m.g. storage basin at Fridley filtration plant, 2 coagulation basins and installing 30 in. main in southwest part of city, 30 or more blocks long.

Mont., Great Falls—Soon takes bids pump house addition. $25,000. E. Henen, city engr.

Okla., Hobart—City Council, A. A. Kirby, mayor, new water supply, incl. dam, pipeline. Election Sept. 28, $250,000 for same. W. R. Holway, 302 East 18th St., Tulsa, engr. This corrects report in Sept. 3 issue.

N. H., Dover—Pumping station. $15,000 or more. W. C. Campbell, supt. Water Dpt. Weston & Sampson, 14 Beacon St., Boston, Mass., engrs.

N. J., Dover—Normandy Beach Water Co., Toms River, installing watermains, valves, hydrants for new waterworks, Dover Twp. $15,000. Private plans.

N. Y., Goshen—Village, water reservoir. Project indefinitely in abeyance. H. B. Cleveland, 255 Bway, New York, engr. Noted July 16.

O., Wellsville—Bd. Control bids in spring, new filtration plant, incl. new meter system, $170,000.

Ore., Eugene—City Comn. bids early in 1932, new filtration plant. $300,000. C. McLean, city engr.

B. C., Victoria—See "Sewers."

Ont., Cornwall—Town, waterworks extension, incl. new mains, hydrants, valves, one 3,900 to 5,000 g.p.m. and one 2,500 g.p.m. pumps, one 1 booster pump, all electric drive. $20,000. W. H. Magwood, Cornwall, engr.

Ont., New Hamburg—Town Council, D. E. Ratz, clk., waterworks and sewage disposal plant as winter unemployment relief. $125,000. Engineers not appointed.

Ont., Sarnia — Watermain extensions in McKenzie, Brock, Vidal, Devine and Queen Sts. $100,000.

Ont., Toronto—For 1 mi. c.i. or steel main in Russell Hill Rd. from Clarendon Ave. to St. Clair Aves. $43,560; also 1 mi. new c.i. main Pope Ave. from Danforth to Browning Aves. $82,280. R. C. Harris, City Hall, engr.

Ont., Woodstock—City, P. Utilities Comn., 5 mi. 12 in. or larger c.i. main, from Sweaburg Springs to city. $400,000. W. G. Ure, Perry St., engr.

BIDS ASKED

Ill., Charleston—Oct. 5, by C. H. Harwood, mayor, and City Council, filtration plant addition, accessories, filter equipment. Consoer, Older & Quinlan, Inc., 1700 Engineering Bldg., Wells St. and Wacker Dr., Chicago, engrs.; adv. E.N.-R. Sept. 24.

Mass., Cambridge—Taking bids Stony Brook Conduit extension, $225,000; bids probably late in October. Fresh Pond Reservoir improvements; Dpt. P. Wks. soon takes bids successive sections large distribution mains, to exceed $300,000. Hazen & Everett, 25 West 43rd St., New York, engrs. Noted June 25.

N. J., Woodbine—Sept. 28, by C. N. Leathem, Jr., State Office Bldg., Trenton, water treatment building at State Colony, Woodbine, for State Dpt. Institutions & Agencies, Trenton. $30,000.

O., Conneaut—Oct. 2, by O. J. Lamont, dir. P. Serv., waterworks improvements, incl. 2,550 lin.ft. 4 ft. rock intake tunnel, submerged inlet crib. George Champe & Associates, 1025 Nicholas Bldg., Toledo, consult. engrs.

Pa., Lancaster—City Council bids about Oct. 15, (3rd unit) sewer and water program, incl. filtration plant, additional sewer lines, pipe lines, $500,000. Total est. $3,500,000. J. N. Chester, Engineers, Clark Bldg., Pittsburgh, engrs.

Tenn., Nashville—Oct. 6, by Bd. P. Wks. at office S. H. McKay, city clk., 14 m.g. filtration plant addition. J. N. Chester, Engineers, Clark Bldg., Pittsburgh, Pa., engrs.

CONTRACTS AWARDED

Ind., Peru—City Council, filtration plant for municipal waterworks, to C. J. Burke, Peru, $141,000. Est. $150,000. Noted Apr. 23.

Mass., Boston — Metropolitan Dist. Water Supply Comn., 20 Somerset St., sinking two 12 x 32 ft. rein.-con. caissons, and sealing to ledge, Swift River Reservoir, to Dravo Contg. Co., Neville Island, Pittsburgh, Pa., $115,900. Noted Aug. 27.

Mich., Detroit—Dpt. Water Supply, gate house, erecting elevated steel water tank, to Sedille-Soltar Co., 312 East Grand Blvd. Est. $20,000.

Minn., Swanville—Village, J. J. McRae, clk., watermains, to Jacobs Bros., Bird Island, $8,100; tower and tank, to Minneapolis-Moline Power Implement Co., 612 Builders Exch., Minneapolis, $4,839—pump house, to C. P. Wilmot, Swanville, $2,650; equipment, to Caircross Co., 786 Eustis St., St. Paul, $1,142. Grand total, $16,731. Noted July 16.

Mont., Hot Springs—City Council, furnishing 24,044 lin.ft. 6- to 16-in. c.i. pipe, fittings, to Pacific States Cast Iron Pipe Co., 287 Washington St., Portland, Ore., $30,762. Noted Aug. 27.

N. J., Paterson — (Passaic Valley Water Comn., 156 Ellison St., furnishing, installing three 1250 kva. single phase transformers for 26,400/2,400 volt service with spare and subsidiary transformers, complete switchboard, switches, instruments, 2.4 mi. transmisison line, etc., to Watson-Flagg Eng. Co., 107 19th Ave., $98,556. Noted Aug. 14.

Pa., Lancaster—See "Sewers."

Pa., Ridgway—G. F. Greiner, boro secy., Ridgway Natl. Bank Bldg., Contr. 1, earth fill dam, appurtenances, enlarging storage dam, earth fill 900 ft. long, 37 ft. high, concrete spillway, 600 cu.yd. excav. Contr. 2, steel core wall for earth fill dam. Contr. 3, c.i. water line, furnishing, installing 4,690 ft. 20 in. and 1,437 ft. 12 in. c.i. pipe, removing, replacing 2,115 ft. existing line, complete with necessary valves, fittings to Williamson Constr. Co., 223 Monroeville Rd., Turtle Creek, $68,250. Noted Aug. 27.

Utah, Tremonton—Replacing present mains with new steel pipe, to Wheelwright Constr. Co., Ogden, $15,000. Est. $18,000.

W. Va., Hollidays Cove—Waterworks extensions to southern corporation limits recently annexed, to J. F. Leech, Steubenville, O., $27,500. Est. $30,000. Noted Sept. 3.

Ont., New Liskeard—Teck Twp., 20,000 lin.ft. 30 in. steel pipe, concrete lined and asphaltum covered in connection with construction aqueduct from McTavish to Gull Lakes, to Dominion Bridge Co., 1111 Beaver Hall Bldg., Montreal, Que. supplying 10, 12, 16 and 24 in. pipe, to National Iron Corp., Cherry St., Toronto; laying pipe, to McNamara Constr. Co., 53 Yonge St., Toronto. Est. $250,000.

Ont., Ottawa—City, gates, sluice valves and venturi water meters, new water level controller, in connection with new filtration plant, to General Supply Co. of Canada Ltd., Sparks St., $11,851 and $13,125 respectively. Noted July 30.

Some of the Week's Large Projects

For further details turn to the appropriate sections in this issue.

Location	*Project*	*Cost*	*Status*
Sewers			
Chicago	Sewage disposal plant extensions, etc	$2,205,000	Contract
Bridges			
San Francisco	Bridge	72,000,000	Bids asked
Grade Crossings			
Whitehall (N. Y.)	Eliminating grade crossing	1,367,500	Proposed
Federal Government			
Washington (D.C.)	Supreme court	9,000,000	Bids asked
Ft. Worth (Tex.)	Hospital	4,000,000	Proposed
Grain Elevators			
Albany	Grain elevator and warehouse	1,500,000	Bids asked
Railways			
Texas	Rebuilding line	1,500,000	Proposed
Factories and Mills			
Allenport (Pa.)	Tube mill	1,000,000	Will build with own forces
Unclassified			
Indianapolis	War memorial	1,058,753	Contract
Fort William (Ont.)	Gas plant	1,500,000	Proposed
Buildings			
Brooklyn	Apartment hotel	1,200,000	Separate contract
Oklahoma City	Church	4,000,000	Proposed
Paterson (N. J.)	Jail and hall of records	3,500,000	Proposed
Newark	Hospital, etc	1,500,000	Bids asked
Raton (N. M.)	Hospital	1,500,000	Proposed
Montreal (Que.)	Hospital and power house	1,000,000	Contract
Cambridge (Mass.)	School	1,500,000	Proposed

See proposed advertising on page 99

Constr. News page 115

LEADITE

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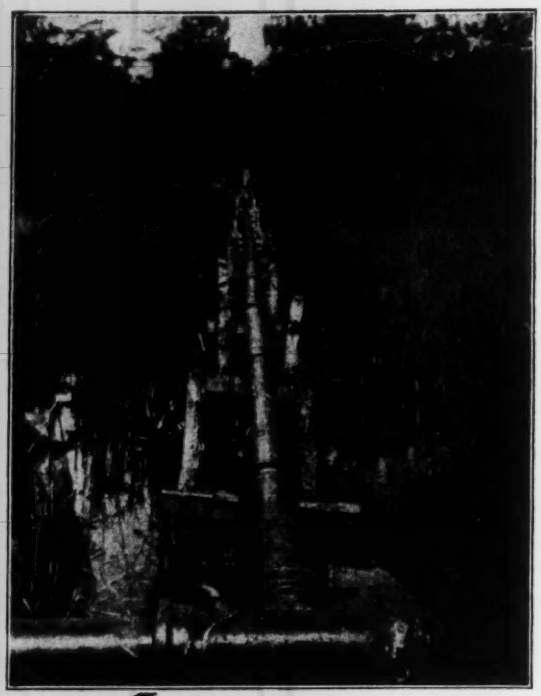

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SEWERS

PROPOSED WORK

Conn., Middletown—Sewage disposal plant. $1,000,000. Project indefinitely in abeyance. T. F. Bowe, 110 William St., New York, consult. engr. Noted Apr. 30.

Ill., Monmouth—City, Bd. Local Impvts., A. Barnum, clk., sewage treatment plant, settling tanks, aerators, drying beds. $125,000. Kinsey Eng. Co., Marshall Bldg., Pekin, engrs.

Mich., Jackson—Disposal plant, system, incl. interceptor sewer, primary and final settling tanks, aeration tanks, pipe gallery, detriter with screen and incinerator, digesters, operating building, sludge beds, piping, main building. $604,900. W. R. Cruse, City Hall, engr.

Minn., Hopkins—Village, A. H. Miller, village recdr., sewage disposal plant. $35,000. Election may be held to vote on financing either project as above or enlargement of present disposal system. E. J. Jeppesen, city engr.

N. J., Long Branch—Long Branch Sewage Disposal Co., sewage disposal works. **Maturity in late fall.** Clyde Potts, 30 Church St., New York, engr. Noted Aug. 19.

N. J., Plainfield—Mayor and City Council, 18 and 36 in. sanitary trunk sewer in Rahway and Norfolk Aves. $100,000.

New York—Westchester Co., Sanitary Comn., White Plains, bids in October, sections of Sheldrake branch of Mamaroneck Trunk Sewer in New Rochelle and Mamaroneck.

O., Willard—Bids in spring, new sewers both sides of town and new main sewer through center of town.

Pa., Meadville—City Council, S. Maxwell, clk., bids in October sewage disposal plant, filter type. $150,000. R. Phillips, City Bldg., engr.

Tex., Houston—City, c/o W. E. Monteith mayor, bids about Oct. 15, rein.-con. storm sewers in Connor St., $50,000 drainage system in Calhoun St. to drain east side of city, $140,000. J. M. Nagle, city engr. Noted Aug. 13.

B. C., Victoria — Sewer and water main improvements, also boulevards. $450,000. Election Dec. 10. $250,000 city's share of cost. F. M. Preston, City Hall, engr.

Ont., Cobourg—Town ¾ mi. 8 in. and up tile sewer in Park St. $25,000. G. Armour, Cobourg, engr.

Ont., Dundas—Council sewer extensions, new water mains, concrete paving Sydenham St. $75,000. J. S. Fry, town clk.

Ont., Fort William—Rein.-con. sewage disposal plant. $250,000. C. B. Symmes, City Hall, engr.

Ont., New Hamburg—See "Waterworks."

Ont., Oshawa—Rein.-con. modern sewage disposal plant, probably activated sludge type. $650,000. F. B. Goedike, City Offices, engr.

Ont., Oshawa—For 8 in. and up vitr. tile, concrete, storm and sanitary sewers. $130,000. F. B. Geodike, City Offices, engr.

Ont., Preston—Council, sewer extensions, $30,000; subway at North St. $28,000. H. Johnston, town engr.

Ont., Sarnia—Storm sewers in Lochiel St., $131,000; in Cotterbury St., $37,700; trunk sewer East St. $13,750.

Ont., Toronto—City, 12 in. and up vitr. tile storm sewers in Queens Park Crescent, St. Joseph and St. Albans Sts. $108,620. R. C. Harris, City Hall, engr.

Ont., Toronto—York Twp. 8 in. and up vitr. tile sewers, concrete and brick manholes. $150,000-$200,000. T. S. Scott, 40 Jarvis St., engr.

Ont., Walkerville—Council, relief storm sewer. $260,000. H. W. Patterson, Imperial Bldg., engr.

BIDS ASKED

Calif., Westmoreland—Oct. 1, by Directors Westmoreland Sanitary Dist., 17,000 ft. 8 in. and 3,000 ft. 12 in. sewers, 51 manholes, flush tanks. Noted Sept. 10.

Ky., Louisville—Sept. 29, by Bd. Comrs. of Sewerage, 400 Marion E. Taylor Bldg., concrete channel 30 ft. wide for section Beargrass Creek, extending from Eastern Parkway to point 300 ft. south with 9 and 14 ft. retaining walls to carry normal flow of creek and storm water drainage Contr. Co. W. M. Caye, c/o owner, technical engr.

Mass., Boston—Sept. 28, by Dpt. P. Wks., J. A. Rourke, comr., sewerage works, Sect. 2 Savin Hill Bay Sewerage, Dorchester. $25,000 or more.

N. Y., North Yonkers—Westchester Sanitary Comn., White Plans, bids about Oct. 15, sterilization plant, Saunders Dock.

N. C., High Point—Sept. 30, by Mayor and City Council, City Hall, furnishing 125 tons Class A, 12 in. bell and spigot c.i. pipe; laying 6,700 lin.ft. 12 in. c.i. pipe; setting 2 pumps, incl. interior piping and changing electrical equipment; reconstructing exterior Henry Perry pumping station. W. C. Olsen, Inc., Raleigh, consult. engr.

O., Akron—Sept. 29, by E. A. Kemmler, dir. P. Serv., Allenside Dist. Sanitary Trunk Sewer, 3,100 ft. 24 and 30 in. vitr. clay pipe, 5,000 ft. piling, 370 rein.-con., $38,500. A. B. Backherms, Municipal Bldg., engr.

O., Cincinnati—Sept. 29, by Bd. Comrs. Hamilton Co., Court House, C. H. Urban, pres., Local Sanitary Sewer 111, Dist. 4, Bommer Farm Subdivision, incl. 1,536 lin.ft. 8 in. vitr. and 122 lin.ft. 8 in. c.i. sewers, necessary manholes, house branches, appurtenances.

Okla., Oklahoma City—Sept. 29, by M. Peshek, city clr., 12,470 ft. 24, 39 and 42 in. concrete pipe, for Rock Island main sanitary sewer. $27,000. L. M. Bush, City Hall, engr.

Okla., Tulsa—Sept. 29, by City Comrs., E. Logan, aud. Sewer, South Section Hartford Ave. No. 3-A-30, incl. concrete manholes, reinforcing bars, 152,000 lb. steel, 18,886 vitr. clay liner plates, 856 ft. 13 x 9 ft. 6 in. and 914 ft. 13 ft. x 10 ft. 6 in. monolithic concrete, 1,318 cu.yd. earth, 440 cu.yd. loose rock and 8,382 cu.yd. solid rock excav. $56,515. H. A. Parker, Municipal Bldg., engr.

Okla., Tulsa—Sept. 29, by City Comrs., E. Logan, aud., 17,730 vitr. clay liner plates, 137,570 lb. reinforcing bars, 1,472 cu.yd. earth, 490 cu.yd. loose rock and 9,228 cu.yd. solid rock excav., concrete materials, manholes, Sewer Project 3-B-30, North Section Hartford Ave. $55,470. H. A. Parker, Municipal Bldg., engr.

Pa., Phila.—Sept. 30, by Dpt. P. Wks. Bureau Eng. & Surveys, City Hall Annex, A. Murdock, dir., Schedule A, branch sewers in Church Lane from 20th St. to Ogontz Ave., Cumberland St. from Front St. to Kensington Ave., 11th St. from Clarkson Ave. to Tabor Rd., Green St. from 3rd to 4th Sts., McKean St. from 26th to 28th Sts., Olney Ave. from 6th to 7th Sts., 70th St. from Paschall Ave. to Linmore St., Wooderest Ave. from 59th St. to Upland Ave., 56th St. from Lindbergh Blvd. to Eastwick Ave. $60,000; Schedule B, new sewer in place of old in Hunting Park Ave. at East River Dr. $30,000; Schedule C, main sewer in Tyson Ave. from Shelborne to Hasbrook Sts., Hasbrook St. from Tyson Ave. to conection with sewerage system of Cheltenham Twp. $20,000; Schedule D, main sewer in Castor Ave. from Frankford to Glenwood Aves., Glenwood Ave. from Castor Ave. to L St. $80,000.

Tex., Sulphur Springs—Oct. 6 (extended date), by City, c/o W. H. Buchanan, secy., sewage disposal plant. H. L. Thackwell, Jacksonville, engr. Noted Sept. 3.

Wash., Spokane—See "Streets and Roads."

Wis., Appleton—Oct. 7, by City, sanitary sewers, laterals in Ravina Pl., Loco and West College Aves., South River, John, 4th, Brewster, Lawrence and Lowe Sts. $25,000. L. M. Schindler, city engr.

CONTRACTS AWARDED

Ill., Chicago—J. J. Sullivan, clk., Sanitary Dist. of Chicago, 910 South Michigan Ave., Calumet Sewage Disposal Plant extensions for aeration tanks, final settling tanks and operating galleries, to Herlihy-Mid-Continent Constr. Co., 20 North Wacker Dr., $2,205,000.

Ill., Millstadt—City Council, system 8- to 15-in. sanitary sewers, primary disposal plant, to A. J. Grabbe Constr. Co., Alton, $33,928. Est. $60,000.

Ky., Louisville—Bd Comrs. of Sewerage, 400 Marion E. Taylor Bldg., Taylor Blvd., Ashland Ave. and Peachtree St. Sewers, rein.con. inverted egg section, from 20 ft. 3 in. x 13 ft. 6 in. to 12 ft. 6 in. x 8 ft. 4 in., to Arundel Corp., Baltimore Bd., $752,316. Noted Aug. 6.

Mich., Dearborn—City, 10 in. monolithic concrete sewer, Sect. 59, River Rouge Interceptor, to S. A. Healy Co., 6561 Seven Mile Rd. E., Detroit, $127,648.

Mo., St. Louis—Bd. P. Serv., City Hall, excavating open channel from Mississippi River to waterworks conduit right-of-way and Maline Creek to Riley Contg. Co., 110 North 7th St., St. Louis, $43,573. Est. $61,000. Noted Aug. 20.

Mo., St. Louis—Bd. P. Serv. City Hall, Wherry Ave., Public Outlet Sewer, 110 ft. open channel sewer, 2,304 ft. 16 to 24 ft. rein.-con. horseshoe sewers in enclosed section, extensive rip rap work in vicinity of sewers open channel, to Martin & Reilly, 7227 Lindell Blvd., $101,334. Noted Sept. 17, under "Contracts Awarded."

N. Y., Brooklyn—H. Hesterberg, pres. Brooklyn Boro, Boro Hall, sewers in Quentin Rd., to Coprib Contg. Co., 1215 82nd St., $8,303. Noted Aug. 19.

N. Y., Greenburgh—Westchester Co., Park Comn., Court House Annex, White Plains, Sec. J, Sawmill Project, 1.33 mi. 66 in. sewer, to A. Gregorio, Inc., 1121 Neil Ave., New York, $223,000. Noted Aug. 20.

N. Y., Long Island City—G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., sewers in Caldwell Ave., to V. Clemente, 1195 Spofford St., New York, $4,277; in 211th St. and Griffin Ave., to Coprit Contg. Co., 1215 82nd St., Brooklyn, $15,687 and $9,135, respectively. Grand total $29,099.

N. Y., St. George—J. A. Lynch, pres., Richmond Boro, Boro Hall, sewer in Bedell Ave., to J. J. O'Rourke, 239 Gordon St., Stapleton, $21,040; curbing Fingerboard Rd., to F. Manzino, $7,905. Noted Sept. 3.

O., Cleveland—Southerly intercepting sewer connection at Kingsbury Rd., Sect. 2, to Cogito Constr. Co., 12616 Corlett Ave., $46,285.

O., Delphos—Sewage disposal plant, to Bever & Morris, Blackstone Bldg., Cleveland, $45,000. Noted Mar. 19.

Pa., Lancaster—City Council, 10 and 12 in. c.i. water-mains in Dorwart, Hazel and South Prince Sts., 12 in. c.i. water-main in Rockland St., 15 in. terra cotta standpipe drain, 36, 84 and 96 in. concrete Water Street Relief sewer and repairs, Little Conestoga Sanitary Interceptor and Force Main, Class B, c.i. pipe and terra cotta Southwest Sanitary Interceptor and Southwest Sanitary Sewer, Charlotte St., Fourth Street Dist. Columbia Ave. and Crystal Street Dist. R. and R. Sewers, to Frank George, 106 North Main St., Akron, O., $394,091; Northwest and Southwest Sanitary Sewers, New Holland Avenue Dist. Sewer, Race, Buchanan and Lemon St. Relief and Replacement Sewer, Nevin St., R. and R. Sewer, to Gallagher & O'Horo, 1816 Wilson Ave., Youngstown, O., $57,219; First St. R. and R. Sewer, to Garson & Garson, 6146 Lebanon St., Phila., $7,254. Grand total $458,564. Noted July 9.

Wis., Milwaukee—Sewerage Comn., furnishing surface condensers, pumps, motors, piping, appurtenances, to Dravo-Doyle Co., 140 South Dearborn St., Chicago, Ill., and Neville Island, Pittsburgh, Pa., $27,900. Noted Aug. 20.

Ont., Kitchener—City, furnishing concrete pipe for trunk sewer, in Edna St. Dist., to J. Schultz, Kent Ave., constructing sewer, day labor, $6,000. S. Shupe, City Hall, engr. Noted Feb. 12.

WASTE DISPOSAL

PROPOSED WORK

N. Y., Brooklyn—Carlite Products Corp., 405 Lexington Ave., plans incinerator foundation, stack, Brightwater Van Dorn and Varick Sts. $40,000.

BRIDGES

PROPOSED WORK

Calif., Bend.—Bd. Comrs. Tehama Co., Red Bluff, cancelled bids steel bridge over Sacramento River, here, due to failure to specify "prevailing rate of wages" to be paid on the construction. Noted Sept. 17.

Calif., Los Angeles—Los Angeles Co. 466 ft. wood pile trestle bridge with steel girders carrying railroad tracks, 40 ft. between curbs, two 5 ft. sidewalks over entrance to Alamitos Bay for vehicular, pedestrian traffic and Pacific Electric Ry. W. D. Armstrong, Hall of Records Bldg., co. bridge engr.

Calif., San Francisco—Oct. 7, by C. H. Purcell, ch. engr., San Francisco Bay Bridge, 500 Sansome St., San Francisco, investigating found. sites for San Francisco Bay Toll Bridge, incl. diamond drill and jet borings, driving castings and test piles, loading piles with test loads, for Calif. State Toll Bridge Authority. $72,000,000.

Mass., Ware—Town, Bd. Selectmen, J. H. Walker, town clk., steel, concrete bridge over Ware River, Palmer Rd. $25,000 or more. Noted Feb. 5.

Mass., Westport—Town, Bd. Selectmen, new bridge at Horseneck Beach. $25,000 or more.

Okla., Oklahoma City—Atchison, Topeka & Santa Fe R. R. Co., 80 East Jackson Blvd., Chicago, Ill., G. W. Harris, ch. engr., 500 ft. steel bridge over North Canadian River.

Ont., Fort William—Council approaches to bascule bridge, $80,000; also road improvements, $50,000, as unemployment relief during winter. R. B. Pow, chn., Bd. Works.

BIDS ASKED

Calif., Bend—Bd. Supervs., Tehama Co., Red Bluff, taking bids steel bridge over Sacramento River. $48,500.

Calif., San Francisco—Sept. 30, by S. J. Hester, secy., Bd. P. Wks., City Hall, Strauss Steel Trunnion Bascule Bridge, incl. substructure, superstructure, approaches over Channel St., Waterway at 3rd St.

Ill., Carlinville—See "Streets and Roads."

Ill., Chicago—See "Streets and Roads."

Ill., East St. Louis—Oct. 15, by East Side Levee & Sanitary Dist., 217 Metropolitan Bldg., Highway Bridge 2 over Project 8, incl. one 130 ft. riveted through truss central span, two 65 ft. riveted pony truss approach spans with 22 ft. rein.-con. roadway on concrete piers, abutments, also double 10 x 5.5 ft. rein.-con. culvert, 90 ft. long with wing walls for auxiliary of Project 8, State Aid Route 39. E. F. Harper, c/o owner, engr. Noted June 19.

Kan., Wichita—City, C. C. Ellis, clk., postponed taking bids 258 ft. rein.-con. bridge, 40 ft. wide over Little Arkansas River at 13th St., incl. 2,092 cu.yd. concrete, 7,610 ft. piling, 1,188 cu.yd. excav., 194,693 lb. reinforcing and 1,116 lb. structural steel, 15,150 lb. cast steel slab plates. $75,000. P. L. Brockway, City Hall, engr. Noted Sept. 3.

Kentucky—See "Streets and Roads."

Maryland—Sept. 29, by State Roads Comn., G. C. Uhl, chn., Baltimore, single span concrete slab bridge, Contr. M-179-37, Montgomery Co.—double span concrete slab bridge, Contr. M-180-37, Montgomery Co.— double span, concrete girder bridge, Contr. P-191-37, Prince George's Co.; adv. E.N.-R., Sept. 24.

Maryland—Oct. 13, by State Roads Comn., G. C. Uhl, chn., Baltimore, double leaf bascule span superstructure, complete bridge Contr. Ce-118-27, Cecil Co.; double leaf bascule span superstructure, complete, Contr. D-84-17, Dorchester Co.; adv. E.N.-R., Sept. 24.

N. H., Pittsburg—Sept. 29, by State Hy. Dpt., Concord, T. L. Bridge, two 107 ft. spans through plate girder over Connecticut River, Coos Co. $37,057.

Okla., Arapaho—Sept. 28, by J. Hatchett, clk. Custer Co., 283 lin.ft. bridge over Washita River, west of Butler, Project 1, Sect. C—181 lin.ft. bridge over West Barnitz Creek, east of Butler, Project 1, Sect. F—181 lin.ft. bridge over Est. Barnitz Creek, east of Butler, Project 1, Sect. G—3,162 lin.ft. bridge over South Canadian River, northeast of Thomas, Project 1, Sect. S—190 lin.ft. bridge over Washita River, north of Custer City, Project 2, Sect. B—141 lin.ft. bridge over Beaver Creek, west of Custer City, Project 1, Sect. L, all concrete, steel. C. R. Reid, Arapaho, consult. engr.

Pa., Phila.—Sept. 30, by Dpt. P. Wks., Bureau Eng. & Surveys, City Hall Annex, A. Murdock, dir., Schedule B, bridges, clearing site of Henry Ave. between Schoolhouse Lane and Wissahicken Creek—Schedule F, single track steel, concrete deck railroad bridge under Philadelphia & Frankford Branch Reading R.R. at Summerdale Ave., $75,000—Schedule G, steel cylinder piles, concrete abutments, wing walls for bridge under Pennsylvania R.R. and Philadelphia, Baltimore & Washington R.R. at University Ave. $250,000.

Pa., Phila.—See "Streets and Roads."

Virginia—See "Streets and Roads."

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Bridges (Continued)

CONTRACTS AWARDED

Maryland—See "Streets and Roads."

New Jersey—State Hy. Comn., Trenton, furnishing, erecting structural steel, Route 25, Connecting Link Sect. 7, 7A and 8, Newark, Essex Co., to Taylor-Fichter Steel Co., 570 7th St., New York, $872,237. Noted Aug. 20.

N. J., New Brunswick—Bd. Freeholders Middlesex Co., Court House, concrete, steel bridge over Green Brook between Middlesex and Somerset Counties, to A. E. Smith, Plainfield, $52,444. Noted Mar. 19.

Wash., Wenatchee—Chelan Co., 3 span, 350 ft. rein.-con. arch bridge over Wenatchee River, to H. Hagman, Cashmere, $48,581.

Alta., Calgary—A. S. Chapman, city mgr., superstructure filtration plant, to J. McDiarmid Co., 201 Nokomis Bldg., Winnipeg, $166,042. Noted Aug. 27.

B. C., Ashcroft—Minister P. Wks., Victoria, 540 ft. steel truss bridge on concrete piers over Thompson River, to Monerieff & Vistanet, Ltd., 119 Pender St. W., Vancouver, $155,000. Noted Aug. 12.

Que., Quebec—Provincial Dpt. P. Wks., substructure Island of Orleans Bridge, to St. Lawrence Eng. & Constr. Co. Ltd., Montreal, $605,300; steel work, to Eastern Canada Steel & Iron Wks., Ltd., Lesage St., $298,700. Noted Apr. 9, under "Quebec."

BIDS RECEIVED

La., New Orleans—State of Louisiana acting through State Advisory Bd., c/o H. P. Long, chn. and City, acting through Public Belt R.R. Comn., c/o T. M. Walmsley, pres., at Council Chamber, City Hall, main span superstructure railroad and hy. bridge over Mississippi River, near here, from Amer. Bridge Co., 208 South La Salle St., Chicago, Ill.; main span substructure, from Siems-Helmars, Inc., 1014 Guardian Bldg., St. Paul, Minn.; approach superstructure, metal work, from McClintic Marshall Corp., Oliver Bldg., Pittsburgh, Pa. Totol set, $19,000000. Noted Aug. 16.

CONTRACTS AWARDED

Indiana—State Hy. Comn., Indianapolis, rein.-con. girder bridge, Jefferson Co., to V. S. Manning, Vincennes, $11,346 est. $16,062—rein-con. arch rein.-con. girder and steel truss bridges Elkhart Co., to P. B. Putman, 2222 Kensington St., Ft. Wayne, $23,590 est. $35,759—rein.-on. girder bridge, Union Co., to C. E. Paxson, West Alexandria, O., $13,888 est. $20,467. Grand total $48,824. Noted Aug. 13.

Iowa—State Hy. Comn., Ames, 6 I-beam bridges and 1,300 cu.yd. fill-in berms, Cass Co., to Duvall & McKinney, Logan, $18,063—2 wood bridges, Jackson Co., to P. Jayne, Cedar Rapids, $2,860—20 x 24 ft. slab bridge extension, Pottawattamie Co., to Wickham Bridge Co., 1905 West Bway., Council Bluffs, $3,050—48 culverts, extensions, Montgomery Co., to Wilson Concrete Co., Red Oak, $31,240—7 culverts, Cass Co., to A. Melberg, Cedar Rapids, $2,390. Grand total, $57,603. Noted Aug. 27.

Ia., Oskaloosa—Auditor Mahaska Co., 126 x 18 ft. high truss bridge with 24 x 18 ft. approach span, and 100 x 18 ft. high truss span with three 40 x 18 ft. I-beam approach spans, to Olson Constr. Co., Waterloo, $21,125—7 items of culverts, to H. E. Whitlatch, Oskaloosa, $2,499—grading 5.6 mi. roads, to Clear Lake Constr. Co., Clear Lake, $6,044. Grand total $29,668.

Kentucky—State Hy. Dpt., Frankfort, abutments, piers, pedestals, pile bents, piles and retaining walls for Winchester Bridge at Ashland, Boyd Co., to Rust Eng. Co., Koppers Bldg., Pittsburgh, Pa., $41,711; twenty-three I-beam and 102 ft. plate girder spans steel towers and bents, concrete flooring, sidewalk stairway, lighting system for above bridge, to E. R. Mills, Covington, $89,665. Noted Aug. 13, under "Streets and Roads."

Maryland—State Roads Comn., G. C. Uhl, chn., Baltimore, concrete arch bridge on Riggs Mill Rd., Contr. P-183-37, Prince Georges Co., to Eastern State Bridge Co., York, Pa., $6,853. Noted Sept. 3.

New Jersey—State Hy. Comn., State House Annex, Trenton, 4 bridges in Burlington Co., to Robbins Constr. Co. 1137 North Front St., Phila. Pa., $45,480. Noted Aug. 27.

Ohio—O. W. Merrell, dir. hys., Columbus, 40 ft. span concrete beam bridge, 24 ft. roadway, Defiance Co., to N. A. G. Sunday, Antwerp, $5,000—12 ft. span, concrete slab bridge, approaches, Franklin Co., to A. W. Burns Constr. Co., 424 Woodland Ave., Columbus, $5,373—two 50 ft. span, steel beam bridge, 30 ft. roadway, two 4 ft. 7 in. sidewalks over Moxahala Creek, Perry Co., to George W. Luke & Son, Canton, $20,850—two 24 ft. span, concrete slab bridge, 24 ft. roadway, Trumbull Co., to Lodi Constr. Co., Lodi, $4,929. Grand total $36,152. Noted Sept. 10, under "Streets and Roads."

Pa., Pittsburgh—R. G. Woodside, controller Allegheny Co., Court House, superstructure Bridge 1, Loweries Run, and superstructure repairs to bridge over Pine Creek at Crescent Ave., to D. Goldberg, Pennsylvania Ave., Uniontown, $2,664 and $7,875, respectively; handrailing on Boston Bridge 6, Youghiogheny River, to Pressed Steel Car Co., McKees Rocks, $22,060. Grand total $32,599.

Tex., Fort Worth—Tarrant Co., c/o W. E. Yancey, and 292 ft. steel, concrete bridge

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over Trinity River, Frey Ave. Extension, to E. Lloyd, 3500 Golney St., $47,313. Est. $48,000. Noted July 31 Daily.

Utah—State Hy. Comn., Salt Lake City, 5 rein.-con. bridge, totaling 547 ft. in length, on Midland Trail, Carbon Co., to Strong & Grant, Springville, $63,805. Est. $75,573.

Que., Chicoutimi—Dpt. P. Wks., Govt. Bldg., Quebec, J. L. Francoeur, minister P. Wks., steel work for bridge, to Eastern Canada Steel & Iron Co., Lesage St., Quebec, $350,000 substructure, to A. Janim Co., Ltd., Montreal, $308,168. Noted Aug. 27.

Que., Montreal—Canadian National Rys., C. S. Gzowski, ch. engr., constr., Montreal, placing 104 x 615 ft. rein.-con. deck and waterproofing on bridge which carries Dorchester St. over excavation for new central passenger station, to E. G. M. Cape & Co., 620 Cathcart St. $150,000.

STREETS AND ROADS

BIDS ASKED

Ark., Mountain Home — See "Contracts Awarded."

California—Sept. 30, by State Hy. Comn., Sacramento, grading, concrete paving 6.2 mi. Redwood City-Oregon Ave. Rd., San Mateo Co.; grading 0.5 mi. approaches to North Fork of Trinity River Bridge, Trinity Co. C. H. Purcell, hy. engr.

Calif., Nevada City—Supervs. Nevada Co., taking bids improving road between Grass Valley and Bear River, incl. 34,800 cu.yd. excav., 6,200 cu.yd. crusher run base, 5,250 cu.yd. crushed rock (salvaged), 3,558 tons broken stone (bituminous macadam surface), 289 tons emulsified asphalt, 825 bbl. fuel oil.

Calif., Newport Beach—Oct. 5, by City Council, ¾ to 1 in. macadam and oil on 6 in. disintegrated granite surfacing 190,250 sq.ft. Seashore Dr.

Calif., Redondo Beach—City Council bids early in October, improving Vincent St. between Bway. and Susana Ave. To exceed $25,000. D. L. Bundy, City Hall, engr.

Calif., Santa Ana—Oct. 6, by Bd. Supervs., Orange Co., grading 125,000 cu.yd. Santiago Canyon Rd.

Ill., Carlinville—Sept. 29, by Bd. Comrs. Macoupin Co., grading 2.7666 mi. Sect. 2A-M.F.T., 30 ft.—2.3982 mi. 3A-M.F.T., 32 ft.—1 rein.-con. bridge, 1 rein.-con. culvert, Sect. 2B-M.F.T.—1 rein.-con. girder bridge, 1 rein.-con. culvert, Sect. 3B-M.F.T. G. H. Baker, c/o State Dpt. P. Wks. & Buildings, Div. Hys., Springfield, engr.

Ill., Chicago—Sept. 29, by Bd. Comrs. Cook Co., County Bldg., improving 0.44 mi. Chicago Rd., 40 Ft., Sect. 150-0505—1.95 mi. Ridgeland Rd., 20 ft., Sect. 043-0607—0.12 mi. Damen Rd. 20 ft., Sect. 169-090—0.54 mi. Vincennes Rd., 20 ft., Sect. 057-1717—0.27 mi. Railroad Ave., 40 ft., Sect. 055-4343-1—0.2 mi. Halsted St., 20 ft., Sect. 060-0304—1.12 mi. Burnham Ave. "O", 20 ft., Sect. 069-1213—0.62 mi. Toughy Ave. (Niles Center), 10 ft., Sect. 130-2828-1—1.94 mi. Caldwell Ave. from Cicero to Tonty Sts. 40 ft., Sect. 042-0607—0.73 mi. Caldwell Ave. from Tonty St. to Gross Point, 40 ft., Sect. 042-0708—1.438 mi. Brennen Ave., 20 ft., Sect. 050-0304—0.0238 mi. Fullerton Ave., 2-10 ft., Sect. 145-1212-1—0.411 mi. Harlem Ave. from 16th to 22nd Sts., 1-10 ft., Sect. 039-2727—1.097 mi. Harlem Ave. from 71st to 63rd Sts., 20 ft., Sect. 03ff-2121—0.781 mi. Burnham Ave., 20 ft., Sect. 069-1111—0.26 mi. Kimball Ave., 40 ft., Sect. 053-3636—0.83 mi. Wentworth Ave., 20 ft., Sect. 070-0203—1.88 mi. Devon Ave., 20 ft., Sect. 135-1921—0.324 mi. 25th Ave. from gap at North Ave., 20 ft., Sect. 020-1010—0.092 mi. 25th Ave. from Chicago & Northwestern R.R., Sect. 020-0808—0.22 mi. Harrison St., 10 ft., Sect. 155-0404—0.75 mi. Devon Ave., 20 ft., Sect. 135-2121—2.296 ft. concrete gutter on 1st Ave., Sect. 033-0204—179th St. culvert, Sect. 196-0101—Cottage Grove Avenue-Little Calumet Bridge, Sect. 063-0909—First Avenue Equestrian Underpass, Sect. 031-0606-2—47th St. Des Plaines River Bridge, Sect. 165-0606. G. H. Baker, c/o State Dpt. P. Wks & Buildings, Div. Hys., Springfield, county road engr.

Ill., Edwardsville—Bd. Comrs. Madison Co. rejected bids Sept. 5, concrete surfacing 1.0366 mi. Sect. 48-15d, 18 ft. W. D. Howden, Court House, engr. Noted Sept. 3.

Ind., Ft. Wayne—Sept. 29, by Bd. P. Wks., S. S. Snyder, secy., concrete paving Euclid Ave. and 3 alleys. $25,000.

Kentucky—Oct. 14, by State Hy. Dpt. Frankfort, grading, drainage structures 5.3 mi. Martin-Weeksbury Rd., Floyd Co.—5.3 mi. South Carrollton-Island Rd.—14.7 mi. Greenville-Rochester Rd., Muhlenberg Co.—three 73 ft. rein.-con. deck girder span concrete overhead crossing, rein.-con. piers, abutments, grading approaches on Russellville-Guthrie Rd., near Guthrie, Todd Co. B. Johnson, chn.

Maryland—Sept. 29, by State Roads Comn., G. C. Uhl, chn., Baltimore, macadam paving 1.03 mi. Contr. M-183-54, Montgomery Co.—gravel surfacing 2.17 mi. Contr. P-167-82, Prince George's Co.—concrete paving 0.51 mi. Contr. P-176-32, Prince George's Co.—1 mi. Contr. Wo-104-12, Worcester Co.; adv. E.N.-R. Sept. 24.

Massachusetts—Sept. 29, by Dpt. P. Wks., A. W. Dean, engr., State House, Boston., bituminous macadam paving 1,290 ft. hy., incl. rein.-con. bridge and steel stringer bridge, Chesterfield and Williamsburg—gravel and bituminous macadam paving 350 ft. hy., incl. penolithic paving 17,531 ft. hy. Chicopee.

Massachusetts—Oct. 6, by Dpt. P. Wks., A. W. Dean, engr., State House, Boston, bituminous macadam paving, incl. extension to stone arch bridge and a rein.-con. bridge, 18,227 ft hy. Dedham, Westwood and Needham; concrete bituminous macadam and gravel and bituminous macadam paving, incl. steel plate girder bridge, concrete pile extension of bridge, 2 steel, concrete bridges, rein.-con. bridge, 29,596 ft. hy. Framingham and Natick.

New Hampshire—Sept. 29, by State Hy. Dpt., Concord, grading, 4 in. on 12 in. gravel base course surfacing 3.81 mi. Daniel Webster Hy., in towns of Stewartson, Clarksville and Pittsburg, Coos Co. $90,000. T. T. Hargraves, Lancaster, engr.

N. J., Trenton—Sept. 29, by Bd. Freeholders Mercer Co., grading, concrete paving 17,557 sq.yd. Olden Ave. extension. H. F. Harris, Trenton, co. engr.

N .Y., Brooklyn—Sept. 30, by H. Hesterberg, pres. Brooklyn Boro, Boro Hall, grading, curbing Avenue W, Dilmas, Troy and 15th Aves., Bragg, East 28th, East 35th, West 3rd, West 12th Sts.

N. Y., Long Island City—Sept. 28, by G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., grading, curbing, sidewalks, sheet asphalt on concrete paving Newtown Rd., Roosevelt, 107th and 119th Aves.—sheet asphalt on macadam paving Justice St.—grading, curbing, sidewalks on Utopia Parkway, Weller and 108th Aves., 162nd, Nettleton and 75th Sts.

Oklahoma—Oct. 6, by State Hy. Dpt., Oklahoma City, concrete slab surfacing 4.6 mi. U. S. Hy. 62, 20 ft., Comanche Co. $73,512. C. L. Wilson, hy. engr.

Okla., Oklahoma City—Sept. 29, by M. Peshek, Jr., city clk., 7 in. concrete paving 9,600 sq.yd. South Harvey St. from Reno to Choctow Sts. $25,490; 11,200 sq.yd. Southwest 29th St. from Virginia to Miller Sts. $40,620. L. M. Bush, City Hall, engr.

Pa., Phila.—Sept. 29, by Bureau Hys., Dpt P. Wks., City Hall Annex, A. Murdock, dir. Schedule A, grading Anderson St. from Southampton to Gravers Sts.—Schedule B, asphalt paving (assessment work) Clarkson St. from Ashmead to Wister Sts.—Devereaux St. from Torresdale to Hegerman Sts.—Poulkrod St. from Lackawanna to Jackson Sts.—Grays St. from 49th to 52nd Sts.—James St. from Friendship to Princeton Sts.—Levick St. from Frankford to Battersby Sts.—Melvale St. from Ontario to Tioga Sts.—Valley St. from Harrison to Jackson Sts.—Windrim St. from Wayne to Germantown Sts.—56th St. from Lindbergh St. to Schuylkill River—Schedule C, country road improving Millet St. from Torresdale to Jackson Sts.—Schedule D, hiring motor trucks for hauling road materials—Schedule F, furnishing, erecting fabricated structural steel smoke plates for Belmont Avenue Bridge—Schedule G, reinforcing columns on Spring Garden Street Bridge—Schedule H, removing, constructing truck platform scales—Schedule I, gunite repairs to Pine Road Bridge.

Tennessee—Oct. 2, by State Dpt. P. Wks & Buildings, Div. Hys., Nashville **(F.A.P. means, Federal Aid Project)**, paving 5 mi. State Hy. 8 between Bachman Tunnel and Georgia state line, F.A.P. 221-A, Hamilton Co.—4 mi. State Hy. 11, between Nashville city limits and station 209-00 (Dickerson Pike), F.A.P. 255-A, Davidson Co.—7 mi. State Hy. 11, between Nolensville and Triune, F.A.P. 256, Williamson Co.—4 mi. State Hy. 19, between Ripley and Arp, F.A.P. 257, Lauderdale Co.—1.2 mi. State Hy. 2, through Sweetwater, F.A.P. 258, Monroe Co.—3.87 mi. State Hy. 36, between Johnson City and Unicoi Co. Line, F.A.P. 259, Washington and Carter Counties. R. H. Baker, comr.

Virginia—Oct. 6, by State Hy. Dpt., Richmond, clearing, grubbing, grading, drainage structures, gravel surfacing 5.4 mi. South Lacy-Stanley Rd., Route 815, Project S-676-A, Page Co.—clearing, grubbing, grading, drainage structures, soiling 4.7 mi. Glade-Hill-Redwood Rd., Route 20, Project S-677-CD, Franklin Co.—widening bridge over Old Town Creek, Route 31, Prospect S-66-B2, near Petersburg, Chesterfield Co., H. G. Shirley, ch. engr.

Washington—Sept. 29, by S. J. Humes, dir. State Hy., Olympia, grading, crushed stone surfacing 22,590 cu.yd. State Rd. 5, Ingalls Hill to Packard Creek, F.A.P. 184-B, King Co.—14,960 cu.yd. State Rd. 9, Purdy Creek-Junction State Rd. 14, F.A.P. 136-D, Mason Co.—clearing, culverts, grading 634,320 cu.yd. State Rd. 9, Montesano to Aberdeen, Grays Harbor Co.

Wash., Seattle—Comrs. King Co. bids about Sept. 30, concrete paving 1 mi. Lake Washington Blvd. $25,000. T. D. Hunt, Seattle, co. engr.

Wisconsin—Sept. 29, by State Hy. Comn. and Juneau Co., Hy. Comn., Wisconsin Rapids, concrete paving, 96,300 sq.yd. New Lisbon-Sparta Rd., U. S. Hys. 12 and 16, F.A.P. 325-C.

Wisconsin—Oct. 2, by State Hy. Comn. and Hy. Com. LaCrosse and Vernon Counties, LaCrosse, grading 0.631 mi. LaCrosse-LaCrescent Rd., U. S. H. 61, S.A.P. 5269, LaCrosse Co.; Hospital Bridge, on S.T.H. 80, S.A.P. 5348, Vernon Co.

Ont., Kenora—See "Contracts Awarded."

CONTRACTS AWARDED

Ala., Birmingham—Granite curbing, concrete guttering, concrete sidewalks, grading, vitrobrick paving 2,875 sq.yd. 22nd St. N., to Dunn Constr. Co., Lincoln Life Bldg., $30,708. Est. $30,000.

Ala., Birmingham—Paving, drainage structures under 18th and 20th St. Underpasses, to H. N. Bowdry, Martin Bldg., $41,870.

Streets and Roads (Continued)

Ark., Mountain Home—Baxter Co., grading, drainage structures 7 mi. road between Mountain Home and Big Flat, day labor.

Calif., Richmond—A. C. Faris, city clk., grading, asphalt concrete paving Hall Ave. and 14th St., to Independent Constr. Co., 213 Richfield Oil Bldg., Oakland, $63,945. Noted Sept. 3.

Calif., Salinas—Montgomery Co., improving Pacific Grove-Carmel and Blanco-Breese Rds., to Granite Constr. Co., Wartsonville, $9,895 and $26,625, respectively.

Connecticut—J. A. Macdonald, state hy. engr., Hartford, gravel and waterbound macadam paving 12,887 ft. hy., Prospect to J. Varvello, 89 Park St., New Haven, $21,945—trap rock waterbound macadam paving 8,230 ft. Windsor, to Lane Constr. Co., 37 Colony St., Meriden, $23,-362—crushed gravel surfacing 38,873 ft. Woodbury, to Innis Bros., Clay St., Thomaston, $13,-805—surface treated gravel surfacing 18,467 ft. Burlington to Altieri & Petruccione, 591 Congress Ave., Waterbury, $8,996—gravel surfacing 10,200 ft. Cornwall, to C. A. Rossi Co., 151 Franklin St., Torrington, $18,751—17,100 ft. Eastford and 19,100 ft. Hampton, to Thompson Constr. Co., Thompson, $12,577 and $16,-128 respectively—19,334 ft. Monroe, to Hy-Way Constr. Co., 73 Steuben St., Bridgeport, $10,988—3,500 ft. Pomfret, to A. Brazos & Sons, Oak St., Middletown, $12,225—loose gravel surfacing 19,804 ft. Ellington, to Town of Ellington, $5,407. Grand total $144,184. Noted Sept. 3.

Connecticut—J. A. Macdonald, state hy. comr., Hartford, gravel surfacing 18,350 ft. Canton, to N. Cena, 36 Brown Pl., Saterbury—11,800 ft. Franklin, to F. D. Miller, Poquetenauk St., Norwich—14,700 ft. Bozrah and gravel surfacing 19,150 ft., 2 bridges, Colebrook, to A. I. Savin, 408 Main St., Hartford—broken stone or crushed gravel surfacing 18,975 ft. Goshen, to H. D. Ives, West Goshen—12,364 ft. Thomaston, to Altieri & Petruccione, 591 Congress Ave., Waterbury—waterbound macadam paving 1,288 ft. Derby and bituminous macadam paving 25,199 ft. West Haven, to Clarke Bazone Co., 595 Legion Ave., New Haven—waterbound macadam paving 10,000 ft. Meriden, to L. Suzio Constr. Co., State and Book Sts., Meriden. Est. exceeds $25,000. Noted Aug. 13.

Idaho—Comrs. P. Wks., Boise, grading, drainage structures, surfacing 2,386 ft.yd. Hayburn Park Hy., Benewah Co., to Morrison Knudson Co., Boise, $75,989.

Ill., Sparta—Randolph Co., improving 6.218 mi. State Road, 30 ft. in vicinity of Chester and Schuline, incl. 75 units hedge pulling, 46,-980 cu.yd. excav., 582 cu.yd. concrete, 54,240 lb. reinforcing steel bars, to J. Kesl & Sons, Edwardsville, $24,955.

Indiana—State Hy. Comn., Indianapolis, grading, drainage structures 4.338 mi. Project 223-A, Gibson Co., to Swords-McDougal, Knapp & Co., 114 Fayette St., Peoria, Ill., $30,957. Est. $39,575. Noted July 9.

Ind., Princeton — Gibson Co., Kentucky rock asphalt surfacing Thomas Nash Rd., to Sweet & Wright, Greencastle, $17,457 est. $27,095—concrete surfacing Hugo Schumacker Rd., to R. D. Manning, Decker, $17,111 est. $24,699—William Martin Rd., to G. Soller, Princeton, $10,395 est. $14,225. Grand total $44,963. Noted Sept. 3.

Iowa—State Hy. Comn., Ames, gravel surfacing 13.765 mi. Primary Rd. 35, P-638 and Divs. 1 and 2 of Primary Rd. 37, M-317, to Evans Constr. Co., Early, $19,882 and $3,950 respectively; Div. 3 of latter project to Kriege Constr. Co., Marshalltown, $2,877. Grand total $26,709.

Ia., Oskaloosa—Mahaska Co., grading 5.6 mi. roads, to Clear Lake Constr. Co., Clear Lake, $6,043; constructing 7 culverts, to H. E. Whitlatch, Oskaloosa, $2,499.

Kentucky—State Hy. Dpt., Frankfort, gravel surfacing 7.349 mi. Calloway Co., to N. E. Stone & Co., Madisonville, $14,314—5.409 mi. Marshall Co., to E. C. Mercer & Co., West Point, $7,879—grading, drainage structures, 0.332 mi. approaches to Winchester Ave. Bridge, at Ashland, Boyd Co., to Rust Eng. Co., Koppers Bldg., Pittsburgh, Pa., $22,157. Grand total $44,350. Noted Aug. 13.

Maryland—State Roads Comn., G. C. Uhl, chn., Baltimore, grading, drainage structures, substructure for bridge over C. & O. Canal, Contr. A-95-62, Allegany Co., to West Virginia Contg. Co., Huntington, W. Va., $178,074; structural steel superstructure for bridge over C. & O. Canal, Contr. AA-99-62, Allegany Co., to Roanoke Iron Bridge Works, Roanoke, Va. $6,941. Noted Aug. 6.

Maryland — State Roads Comn., Baltimore, G. C. Uhl, chn., gravel surfacing 2.5 mi. Contr. C-46-84, Calvert Co., to Southern Maryland Contg. Co., 20 East Lexington St., Baltimore, $19,834. Noted June 25.

Maryland—State Roads Comn., G. C. Uhl, chn., Baltimore, concrete paving 1 mi. Contr. WO-103-14, Worcester Co., to Phillips Bros., Salisbury, $19,928. Noted Sept. 10.

Massachusetts—Dpt. P. Wks., State House, Boston, A. W. Dean, engr., rein.-con. paving 22,-151 ft. hy., incl. steel plate girder and rein.-con. bridges, Uxbridge, to Lane Constr. Corp., 37 Colony St., Meriden, Conn., $266,548. Noted Aug. 20.

Massachusetts—Dpt. P. Wks., A. W. Dean, engr., State House, Boston, bituminous macadam paving 4,500 ft. hy. Medway, to Arute Bros., New Britain, Conn., $22,813—4,700 ft. Sunderland, to Kelliher Corp., Turners Falls, $17,984—6,250 ft. Amherst, to R.M. Wright, 116 Denver St., Springfield, $28,000—4,600 ft. Sutton, to R. T. Fay, New Bedford, $22,369—rein.-con. paving 4,808 ft. hy. Hingman, to Thomas Walen & Sons, 54 Dover St., Whitman, $31,732—constructing state road in Ashburnham, to A. Pallatto, Bridge St., Dracut, $18,607. Grand total, $131,505. Noted Sept. 3.

Massachusetts—Dpt. P. Wks., Boston, A. W. Dean, engr., bituminous macadam paving 7,170 ft. hy. Marblehead, to S. Rotundi & Son, 404 Franklin St., Stoneham, $27,562; 485 ft. Bridgewater, to Powers Bros., Brockton, $8,795—rein.-con. paving 4,053 ft. Melrose, to A. DeStefano & Sons, Inc., 288 Summer St., East Boston, $36,371. Grand total, $72,728. Noted Aug. 27.

Mass., Boston—Dpt. P. Wks., J. A. Rourke, comr., sheet asphalt paving Governor Rd., to J. R. Beatty, 66 Warren St., Brighton. Est. $25,000.

Mass., Boston—Dpt. P. Wks., sheet asphalt paving Western Ave., Ward 22, to A. R. Doyle, 44 Perkins St., Jamaica Plain, $47,127. Noted Sept. 11. Daily.

Mass., Boston—Dpt. P. Wks., J. A. Rourke, comr., sheet asphalt paving Charlemont St., Ward 16, to C. Capone, 44 Wellsmere Rd., Roslindale, $21,064. Est. $25,000.

Mass., Waltham—Middlesex Co. Comn., roads, walks, paths, grading, etc., about Middlesex Co. Sanatorium, to James Driscoll & Son, Inc., 94 Washington St., Brookline, $39,917. Noted Aug. 20.

Michigan—H. G. Oakes, div. engr., Plymouth, grading, shaping, drainage structures, concrete paving 0.61 mi. FO50-23C-2 Macomb Co., for State Hy. Dpt., Lansing, to Jas. A. McKay & Son, 16549 Woodward St., Detroit, $25,770, incl. cement.

Minnesota—State Hy. Dpt., St. Paul, and City of St. Paul, paving 76,000 sq.yd. trunk hy. through St. Paul, to J. F. McLoughlin & Son, Mankato, at $1.60 per sq.yd.; 4,000 sq.yd. same road, to Lundin Bros., Mankato, $3,936.

Minnesota—State Hy. Dpt., St. Paul, grading 99,000 cu.yd. State Projects 30-22, 30-27, 30-29 and 8-52, to T. Polin, Plummer, $20,095—183,400 cu.yd. State Projects 34-21 and 22, to Franzeen Bros., Palisade, $37,092—360,000 cu.yd. S. P. 47-21, Sect. 2, to Lobnitz Bros., Willmar, $51,266—770,000 cu.yd. S. P. 58-21, Sect. 2 and 347,900 cu.yd. S. P. 59-27, Sect. 2, to C. Weaver, Anoka, $241,959 and $92,719 respectively. Grand total $443,131. Noted Sept. 3.

Mo., Independence—City Council, earth and rock excavating 17,000 cu.yd. Nolan Ave., to F. E. Botts, 908 West Maple St., at $0.249 and $1.25 per cu.yd. respectively. Noted Aug. 6.

Mo., St. Louis—Bd. Pub. Serv., City Hall, to Central Paving & Constr. Co., 411 North 7th St., asphalt paving Hodiament Ave., $26,973—to bituminous Paving Co., Railway Exch. Bldg., Warrenite bithulitic paving Juniara St. $33,219—to Flinn Paving Co., 1405 South 1st St., asphaltic concrete paving Delor St. $19,641; Neosho St., $19,069; Walsh St. $18,-710; Nottingham St. $2,646; Devonshire St. $2,254; Itaska St. $1,508—to Ansbro & Maguire, 4833 Parker Ave., 1,986 ft. 6- to 20-in. c.i. pipe and concrete walk Morganford Rd. $4,195; 1,660 lin.ft. 6- to 20-in. c.i. mains in Morgan St. $2,350. Grand total $130,560. Noted Aug. 12.

Montana—State Hy. Comn., Helena, paving Nine Mile Rd., Silver Bow Co., to Hunt & Shannon, Butte, $11,842, est. $11,480—8.725 mi. Jefferson Co., to J. C. O'Connor, Butte, $20,-958, est. $28,867—19,282 mi. Liberty and Hill Counties, to Goble Constr. Co., Rapid City, S. D., $68,857, est. $123,340—12 mi. Dawson Co., to M. E. Thompson, Minot, N. D., $31,-217, est. $54,924—12.267 mi. Flathead Co., to H. Pickus Constr. Co., Sioux City, Ia., $31,252, est. $48,870—grading 6.566 mi. Jefferson Co. and 20.378 mi. Custer and Powder River Counties to Stanley Bros., St. Cloud, Minn., $73,782, and $69,157 respectively, est. $104,113 and $92,508 respectively—grading surfacing 12.919 mi. Teton and Cascade Counties, to Larson Erling Co., Sioux Falls, S. D., $71,704, est. $103,518—improving 10 mi. Sweet Grass and Stillwater Counties, to Tomlinson Arkwright Constr. Co., Great Falls, $52,132, est. $13,352—reconstruction 10.103 mi. Hill Co., to Western Bridge Constr. Co., Rapid City, S. D., $62,-648, est. $87,504. Grand total $421,844.

Neb., North Platte—City Council, grading, curbing, sheet asphalt paving 23,000 sq.yd., to Abel Constr. Co., 308-11 Terminal Bldg., Lincoln, $57,500.

Nevada—State Hy. Comn., Carson City, oiling state hy from 10 mi. southeast of Las Vegas and Boulder City, Clark Co., to A. D. Drumm, Jr., Fallon, $17,765. Noted Aug. 27.

New Jersey—State Hy. Comn., Trenton, grading, 9 in. rein.-con. paving, 32,000 sq.yd. Middlesex Co., to Utility Constr. Co., New Brunswick, $94,622; 8 in. rein.-con. paving 2,850 sq.yd., Gloucester Co., to Matazzo Constr. Co., Merchantville, $7,187. Noted Sept. 3.

New Hampshire—State Hy. Dpt., Concord, 6 in. one course, rein.-con. on 3 in. gravel paving 4.88 mi. Daniel Webster Hy., Hillsboro Co., to Carlo Bianchi & Co., Framingham, Mass., $105,183, est. $153,000—3 in. on 5 in. gravel surfacing 2.32 mi. Catamount Rd., Merrimack Co., to R. G. Watkins & Son, Inc., Amesbury, Mass., $19,576 est. $33,000—1.62 mi. Dartmouth College Rd., Cheshire Co., to Ricci & Stocker, Claremont, $42,742 est. $64,000. Grand total $167,501. Noted Aug. 27 and Sept. 3.

N. J., Linden—Mayor and City Council, paving Summit St. and Dill Ave., to L. DiFrensesco, Inc., Westfield, $22,653.

N. J., Neptune City—Boro Council, rein.-con. paving Sylvania Ave., to D. S. Tyson, Morrisville, Pa., $22,316. Noted Sept. 3.

N. J., Trenton—Hopewell Twp. Com., bituminous penetration macadam paving 19,200 sq.yd. Bear Tavern-Jacobs Creek Rd., to Grant Constr. Co., Morrisville, Pa., $51,399.

New York—Westchester Co. Park Comn., 72 West Pondfield Rd., Bronxville, grading, drainage 4.04 mi. Saw Mill River Parkway from King St., Chappaqua to West St., Mt. Kisco, Contr. 362, to Barber & Coccola, 58 Purchase St., Rye, $219,570. Noted Aug. 27.

N. Y., Brooklyn—H. Hesterberg, pres., Brooklyn Boro., Boro Hall, paving Adams St., to Walthaw Corp., $39,104; South 4th St., to C. R. Contg. Co., 2266 Gravesend Ave., $10,827. Noted July 30.

N. Y., Brooklyn—H. Hesterberg, pres. Brooklyn Boro, Boro Hall, to Brooklyn Alcatraz Asphalt Paving Co., 407 Hamilton Ave., asphalt paving Ashland Pl., $7,383.—to B. Turricano Contg. Co., New Cropsey Lane, East 52nd St. $7,663; Avenue H $16,057; Avenue I $28,821; Avenue J $20,176; Avenue K $17,389; concrete paving East 59th St. $20,832—to Meehan Paving Co., 90 West St., New York, granite block paving Flushing Ave. $43,606. Grand total $161,927. Noted Aug. 26. Daily.

N. Y., Long Island City—G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., to W. Probeck, grading 124th St., $24,832; 53rd Dr. $5,403; 70th St. $2,402—to Carbloc Paving Co., Stagg St., Brooklyn, asphalt paving Sutter Ave. $4,466—to Boro Asphalt Co., 1301 Metropolitan Ave., Brooklyn, 40th Rd. $3,383 —to A. M. Hagell, Inc., 26 Courtlandt St., New York, sand fill Beach 14th St., $21,000—to Slattery Contg. Co., 7202 51st St., 75th St., $9,480—to Brugel Co., 1154 Cypress Ave., Ridgewood, Amory St. $1,419. Grand total $72,385. Noted Aug. 26 Daily.

N. Y., St. George—J. A. Lynch, pres. Richmond Boro, Boro Hall, bituminous macadam paving Gifford Lane to Vanbro Constr. Co., 24 Elizabeth St., West New Brighton, $6,668; grading Willow Brook Rd., to Lauria Constr. Co., 151 Bway., West New Brighton, $4,827. Noted Aug. 19.

N. Y., St. George—J. A. Lynch, pres. Richmond Boro, Boro Hall, bituminous concrete repaving Trantor Pl. to J. E. Donovan, 2205 Richmond Terrace, Port Richmond, $30,229; asphalt block or repaving, to Vanbro Constr. Co., 24 Elizabeth St., West New Brighton, $13,360. Noted Aug. 26.

N. Y., St. George—J. A. Lynch, pres. Richmond Boro, Boro Hall, bituminous concrete paving Hillside Terrace, to Highway Impvt. & Repair Co., Furmans Island, Brooklyn, $10,010. Noted Aug. 6

Ohio — O. W. Merrell, dir. hys., Columbus, sheet asphalt paving 1.07 mi. Crawford Co., to Mansfield Asphalt Paving Co., Mansfield, $31,-645—brick paving, incl. furnishing, delivering brick Sect. "Worthington" Dublin-Granville Rd., Franklin Co. to A. W. Burns Constr. Co., 424 Woodland Ave., Columbus, $36,943 — brick paving 2.844 mi. Hamilton Co., to Clements-Orr Co., Cleveland, $278,766—grading, drainage structures, tar macadam resurfacing 0.127 mi. Ottawa Co., to Weis Bros. & Burman, Elmore, $7,447 — widening, concrete and macadam paving 8.876 mi. Seneca Co. to Lee Bros. & Petticord, Clyde, $71,118. Grand total $425,-919. Noted Sept. 10.

O., Cleveland—Cuyahoga Co., granite curbing, grading, granite block paving 10,400 ft. St. Clair Ave., to Roehl Bros. Constr. Co., 7002 Denison Ave., $79,215. Est. $92,000. Noted Aug. 27.

O., Medina—Medina Co., grading, drainage structures, waterbound macadam paving 14 mi. roads in Litchfield, Chatham, York and Lafayette Twps., and 6.045 mi. roads in Homer, Harrisville and Spencer Twps., to E. H. Deibel, Medina, $21,462 and $11,151, respectively—12 mi. roads in Brunswick, Hickly and Liverpool Twps., to H. F. Spilker, Medina, $22,282. Grand total $54,895.

O., Ravenna—Paving several small streets in downtown section to McCourt Constr. Co., 365 South Main St., Akron, $27,752. Est. $30,000.

O., Steubenville—Paving approaches to Washington St. Underpass, to H. M. Bates Constr. Co., Steubenville, $27,274. Est. $30,000.

O., Wooster—For brick on concrete paving Cleveland Rd., to Holmes Co., Constr. Co., Wooster, $49,274. Est. $88,471.

Oklahoma—State Hy. Dpt. Oklahoma City **(F.A.P. means Federal Aid Project)** concrete slab surfacing 6.922 mi. Kay Co., to Highway Constr. Co., Daniels Bldg., Tulsa, $92,814. Est. $100,000—7.11 mi. F.A.P. 249-A and 3.539 mi. F.A.P. R-18-K, Muskogee Co., to Ellis & Lewis, 507 Surety Bldg., Muskogee, $93,672 and $52,-660, respectively, est. $100,000 and $65,000, respectively—5 mi. F.A.P. 221-D and 5.19 mi. F.A.P. 221-F, Pottawatomie Co., to S. O. Maxey & Co., Durant, $77,845 and $75,354, respectively est. $80,000 and $83,000, respectively—7.71 mi. Seminole Co., to Hyde Constr. Co., Amer. Bank Bldg., Enid, $108,513 est. $115,000. Grand total $500,858. Noted Sept. 3.

Pennsylvania — State Hy. Dpt., Harrisburg, grading, drainage structures, concrete surfacing 18,200 sq.yd. Routes 64, 65 and 66, Clarion Boro, Clarion Co., to Blue Ridge Constr. Co., Uniontown, $40,687; 668 sq.yd. road in Montgomery Co., also two 34 ft. span rein.-con. bridge to Glenside Constr. Co., Reading, $15,164. Noted Aug. 20.

Pennsylvania—State Hy. Dpt., Harrisburg, rein.con. paving 897 ft. Center Co., 40 and 53 ft., to E. Stall, Altoona, $16,117—814 ft. Armstrong Co., to R. Hopkins, North Pearl and Londonville Sts., Albany, N. Y., $5,723—1,197 ft. Allegheny Co., to Union Paving Co., 1626 Architects Bldg., Phila., $9,667, both 18 ft.—780 ft. Montgomery Co., 20 ft. to F. Feraco, 3632 North Lawrence St., Phila., $4,980—18,871 ft. McKean Co., 18 ft., to Gray Bros., Seward, $79,172—4,389 ft. Venango Co., 20 ft., to M. A. McCormick, Inc., Erie, $26,-

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Streets and Roads (Continued)

618—1,239 ft. Cameron Co., 18 ft., to Independent Constr. Co., DuBois, $31,383; Grand total $173,560. Noted Aug. 27.

Pa., Phila.—Bureau Hys., Dpt. P. Wks., City Hall Annex, to F. Feraco, 3926 North Lawrence St., grading Fanshawe St. from Oxford to Sumneradale Sts., Kerper St. from Oxford to Pennyway Sts., and Pennyway and Whitaker Sts. from Magee to Knorr Sts. $7,700; Longshore St. from Castor to Loretto Sts. $300—to F. Mark Constr. Co., Castor and Winghocking Sts., Hutchinson St. from Nedro to Champlost Sts. $8,100—to Eastern Asphalt Co., Pennsylvania Bldg., asphalt paving (assessment work) B St. (excluding portions under bridges) from Venango to Erie Sts. $11,000; Mascher St. from Duncannon to Tabor Sts. $10,000—to Union Paving Co., Broad and Stiles Sts., Balfour St. from Victoria to Pacific Sts. and Pacific St. from Bath to Balfour Sts., $4,400; Greenway St. from Salford to 59th Sts. $5,600 asphalt repaving 9th St. from Susquehanna to Huntington Sts. $18,600; 36th St. from Grays Ferry to Reed Sts. $8,800, country road improving Meade St. from Shawnee to Navajo Sts. $5,600—to Liberty Corp., Delaware and Orthodox Sts., ready mixed concrete. $900. Grand total $81,000. Noted Sept. 3.

Tex., Beaumont—City, c/o P. H. Millard, mgr., 1 in. duraco on concrete paving Franklin St. from 4th to Houston Sts. and 4th St. from Washington to Franklin Sts., to Broussard & Warfield Co., Beaumont, $64,131; 1 in. asphalt on rein.-con. paving 4th Ave. from Laurel St. to Texas & New Orleans Rd.; Avenue E from College to Cartwright Sts. and Emile St. from Royal to Corley Sts., to S. Shambough, 1401 Dowling St., Houston, $83,093. Noted Aug. 26. Daily.

Tex., Bryan—City, c/o R. G. Williams, mgr., concrete slab paving College Ave. through city, to Thurber Constr. Co., Fort Worth Natl. Bank Bldg., Fort Worth, $31,000. State Hy. Comn. appropriated $15,000. City to pay balance of

Tex., Houston—City and Harris Co., at office City Secretary, 2 in. asphalt on 6 in. concrete paving 20th Ave. from North Main to Rutland Sts. and North Main St. from Airline Dr. and 20th St. to Brown & Root, Inc., Box 3, $43,100 and $33,348, respectively. Noted Aug. 20.

Wash., Kelso — Cowlitz Co., constructing 5.1 mi. Permanent Hy. 17 West Kelso, to H. Niblett, Longview, $42,117. Noted Aug. 6.

West Virginia—State Hy. Comn., Charleston, grading, drainage structures 2.8 mi. Boone Co.: to H. Hatfield, Barboursville, $39,125—10 mi. Monroe Co., to J. Frank, Clinchport, $86,806—grading, drainage structures, shale surfacing 4.08 mi. Doddridge Co., to Hope Constr. Co., Louisa, Ky., $57,259—8.6 mi. Hampshire Co., to Chandler Bros., Virginlina, Va., $118,672—7 mi. Mineral Co., to Langhorn & Langhorn, Huntington, $80,999—interoca on stone surfacing 0.4 mi. Louisburg Rd., and grading, drainage structures, surfacing 0.2 mi. approaches to Caldwell Bridge, Greenbrier Co., to Echols Bros., Alderson, $23,115 and $12,212 respectively—concrete surfacing 0.2 mi. Weirton-Overhead, Hancock Co., to B. C. Springer & Co., Rayland, O., $14,769—surface, treating 8.5 mi. Mason Co., to Southern Oil & Tar Co., Clay St. and River Rd., Louisville, Ky., $15,275—6 mi. Horsepen-Justice Rd. and 8.5 mi. Island Creek-Horsepen Rd., Mingo Co., to Carey-Reed Co., Lexington, Ky., $12,249 and $19,317 respectively—improving Paw Paw-Hampshire Rd., Morgan Co., to Lincoln Constr. Co., Youngstown, O., $86,173—Hutsonville-Piffle School Rd., Randolph Co., to S. G. Polino, Fairmont, $122,176—Spencer-Cemetery Hill Rd., Roane Co., to Boso & Ritchie, Ravenswood, $68,505. Grand total $756,652. Noted May 27.

W. Va., Charleston—Kanawha Co., grading, drainage structures 3 mi. Ronda-Giles Rd., to H. Hatfield, Barboursville, $29,894.

Wisconsin—State Hy. Comn. and Dodge Co., Madison, grading, draining Port Washington-Horican-Fox Lake Rd., S.T.H. 33, F.P. 4446, Dodge Co., to J. and S. Constr. Co., Stoughton, $14,230. Noted Aug. 28.

Wisconsin—State Hy. Comn. and Hy. Com. Dane Co., Madison, grading 0.14 mi. town road in Albion, to I. Napstad, Madison, $800—1.5 mi. road Blue Mounds, to T. Ayen, Mount Horeb, $2,634—graveling 1.25 mi. road, Cross Plains, to Rein & Dahl, Stoughton, $720—1.25 mi. and 2 mi. roads in Cross Plains, to W. Rees, Delafield, $900 and $1,904 respectively—grading 1.22 mi. and 1.41 mi. Oregon, to F. Kutzke, Brooklyn, $1,780 and $1,857 respectively—1.46 mi. and 4.09 mi. Oregon, to E. F. Gallagher, Oregon—10.3 mi. Blue Mount and Vermont, to G. Hughes, Arena, $12,119—grading Main St., to C. H. Olson, Madison, $2,121—constructing Deneen Cattle Pass, Vermont, to W. Granberg, Blanchardville, $432.

Wisconsin—State Hy. Comn., Madison, grading Port Washington-Fox Lake Rd., Dodge Co., to J. and S. Constr. Co., Stoughton, $14,230—grading, bridging Laona-Michigan Line Rd., Marinette Co., to R. B. Vickery & Co., Suamico, $48,239—concrete paving 13,209 sq.yd., Racine Co., to J. Cape & Sons, Racine, $26,147—15,335 sq.yd., Manitowoc Co., to Streu Constr. Co., Two Rivers, $26,353—30,463 sq.yd., Walworth Co., to L. L. Tindall, Waterford, $54,806—119,269 sq.yd. Brown and Calumet Counties to Lex Constr. Co., West Allis, $169,149—136,908 sq.yd., Monroe Co., to P. T. Fess, Madison, $237,639—constructing Mudcreek Bridge, Winnebago Co., to Wunderlich & Bleick, Appleton, $4,321—Embrass River Bridge, Outagamie Co., to Milwaukee Bridge Co., 1410 31th St., Milwaukee, $22,682—Winkler Bridge, Calumet Co., to Wilkinson & Braatz, Waupun, $1,235. Grand total $604,801.

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Wisconsin—State Hy. Comn. and Unemployment Comn., Madison, improving West Hayton Approaches, Calumet Co., to J. O'Keefe, Depere, $17,376—Siding Approaches, Winnebago Co., to O'Hara & Clark, Wauwatosa, $10,205—West Forest Junction Overhead Approaches, Calumet Co., to M. Martin, Berlin, $17,611—Green Acres Overhead Approaches, La Crosee Co., to J. C. Reinke, Bonduel, $21,392— Oshkosh Overhead Approaches, Winnebago Co., to C. F. Wusow, 1067 39th St., Milwaukee, $19,928—Genz Overhead, Kenosha Crossing, to H. C. Brogan, 135 Wells St., Milwaukee, $17,682—Lien Overhead, Walworth Co., to W. E. Stone, Whitewater, $14,260—St. Croix Falls-Turtle Lake Rd., Polk Co., to C. J. Koehler, 610 85th St., Wauwatosa, $91,464. Grand total $209,918. Noted Sept. 10.

Wisconsin—State Hy. Comn., Court House, Elkhorn, grading Omicorn Falls-Maple Rd. Douglas Co., to J. Runquist & Son, 318 Manhattan Bldg., Duluth, Minn., $90,001—Green Bay Rd., Racine Co., to J. Cape & Sons, Racine, $26,147—Williams Bay-Walworth Rd., Walworth Co., to L. L. Tindall Paving Co., Waterford, $54,806. Grand total $170,954. Noted Sept. 3.

Wis., Green Bay—Marinette Co., amiesite surfacing 11.3 mi. Pembine-Niagara Rd., to J. P. Humphries, 2951 North Downer Ave., Milwaukee, $120,590. Est. $120,000.

Wis., Milwaukee—Paving North Hawley Rd., to Jacobus & Winding, 1 State St., Wauwatosa, $24,251; North 31st St., to Bodeman Constr. Co., 2803 North 55th St., $3,119; West Roosevelt Dr., to Czerwinski Constr. Co., South 16th St. and West Morgan Ave., $6,065. Grand total $33,435.

Wyoming—State Hy. Comn., Cheyenne, to Taggert Constr. Co., Cody, graveling 12.293 mi. Cody-Powell Rd., Park Co., $10,948; 8.14 mi. Worland-Manderson Rd., Big Horn Co., $18,029; grade raise and 2 timber bridges on 1 mi. Moneta-Shoshoni Rd., Fremont Co. $3,394—to Clyde & Whiting, Springville, Utah, 4.257 mi. Evanston-Randolph Rd., Uinta Co. $4,695; 10.16 mi. Kemmerer-Fossil Rd., Lincoln Co., $11,160—to Wyoming Constr. Co., Laramie, Hillsdale and Burns Connection on Cheyenne-Pine Bluffs Rd., Laramie Co. $10,515—to Northwestern Eng. Co., Rapid City, S.D., 4 concrete box culverts, arch bridge, on 10.08 mi. Four Corners-Sundance Rd., Weston Co. $50,226. Grand total $108,967. Noted Sept. 3, Daily.

Ont., Brockville—Leeds Co., E. R. Blackwell, engr., Court House, mixed macadam paving 5 mi. road from Crosby Corner to Newboro. 4 mi. County Rd. 19 and amiesite paving 1 mi. County Rd. 3, to Rayner Constr. Co., Ltd., 159 Bay St., Toronto. Est. $100,000.

Ont., Kenora—Dominion Govt. & Dpt. Northern Development, Parliament Bldgs., Toronto, clearing, grading, culverts, bridges, 400 mi. new hy. from Kenora to Heron Bay, part of trans-Canada Hy., day labor, this year as unemployment relief. To exceed $4,000,000. J. Sinton, Parliament Bldg., Toronto, engr.

Ont., Toronto—City, asphalt paving Jedburgh Rd. and Ridley Blvd., to Constructing & Paving Co., Confederation Life Bldg., $2,794 and $4,759 respectively—Coldstream Ave., to Law Constr. Co., Ltd., 225 Sterling Rd., $8,585—Leslie St., to Kilmer & Barber, Harbour Bldg., $4,989—concrete paving 4 lanes, to E. Mark, 1903 Davenport Rd., $6,793—2 lanes, to P. Delgreco, 60 Montcalm Ave., $7,099—lane near Queen St., to J. Battisto, 25 Anderson Ave., $477—lane near Robinson St., to L. P. Acri, 28 Grove Ave., $1,722. Grand total $37,218.

Ont., Toronto—See "Sports and Parks."

Ont., Toronto — To Grant Contg. Co., Ltd., 47 Wellington St. E., concrete paving Leslie Ave., Contr. A, $21,001 Contr. B, $22,044—to L. P. Acri, 28 Grove Ave., lane 1st north of Argyle St., $3,241 lane 1st south of Dundas St., $6,040; lane 1st west of Lisgar St., $1,448; lane 1st west of Logan Ave., $2,116. Grand total, $55,890.

Quebec—Provincial Govt., Quebec, bituminous paving Montreal-Hull-Maniwaki Hy., at Thurso-Lochaber West, Buckingham Southeast, to Bitumen Products Corp., 3590 St. Patrick St., Montreal, $133,718; graveling Buckingham-Mulgrave Hy., to Wright Builders Supply, Ltd., Hull, $14,669, both in Papineau Co.

EXCAVATION, DRAINAGE, IRRIGATION, LEVEES, RIVER AND HARBOR

PROPOSED WORK

Calif., Linden—See "Waterworks."

Calif., Santa Monica—City, 2,000 ft. breakwater and yacht harbor; $690,000 voted for same. H. B. Carter, City Hall, engr. Noted Aug. 27.

Ont., Toronto—City, Parks Dpt. rebuilding 3,000 ft. existing concrete sea wall $294,000; constructing 900 ft. new sea wall $160,000, at Exhibition Park. R. C. Harris, City Hall, engr.

Ont., Toronto—City beach protection, incl. groins, concrete walls, piling, in Kew Beach Dist. from Kew Gardens easterly. $141,000. R. C. Harris, City Hall, engr.

BIDS ASKED

Louisiana—Sept. 30, by Bd. State Engineers, 207 New Orleans Court Bldg., New Orleans, Fort Jackson to Jump-Back Levee, Buras Levee Dist., Plaquemines Parish, incl. 41,850 ft. levee work, 150,000 cu.yd. excav.; Johnson Bayou Cross Levee, Red River and Bayou des Glaises Levee & Drainage Dist., Avoyelles Parish, incl. 700 ft. levee work, 7,600 cu.yd. excav.

Mass., Boston—Oct. 6, by Park Dpt., Beacon St., dredging, filling, East Boston Airport. To exceed $25,000.

N. Y., Brooklyn—Oct. 1, by J. McKenzie, comr. Docks, Pier "A", Battery Pl., New York, dredging in Paerdagat Basin, Jamaica Bay, incl. bulkhead, dikes, etc., Contr. 2047.

Pa., Glenshaw—See "Grade Crossings."

CONTRACTS AWARDED

Ind., Anderson—Madison Co., dredging 23 mi., incl. 387,580 cu.yd. excav., to Bremen Dredge Co., Bremen, $32,000. Est. $38,000.

Ky., Louisville—Bd. Comrs. Jefferson Co., straightening, improving channel South Fork Beargrass Creek from City-County boundary south of Eastern Parkway to Newburg Rd., incl. 200,000 cu.yd. earth excav., own forces, $35,000. M. Drane, Court House, co. engr. Noted Aug. 27.

Mass., Fall River—City, City Auditor, City Hall, concrete retaining wall between city land and Pepperell Mfg. Co., to Wm. Dorley, 221 Whipple St., at $4.50 per cu.yd. rock excav. Noted Sept. 10.

Mass., Winthrop—Metropolitan Dist. Comn., 20 Somerset St., Boston, repairing shore protection, to M. McDonough Co., Saugus, $9,285.

Wash., Walla Walla—Bulkheading, 1,131 ft. north side creek to F. Dill, Walla Walla, $10,983:; and 2,477 ft. south side, to G. Harding, Walla Walla, $25,158.

Ont., Key Harbour—Dpt. P. Wks., N. Desjardins, Ottawa, secy., dredging, to C. S. Boone Dredging & Constr. Co., Ltd., Excelsior Bldg., Toronto, $54,980.

Ont., Kingston—Dpt. P. Wks., Ottawa, W. Desjardins, secy., dredging Little Cataraqui Bay, to Russell Constr. Co. Ltd., Harbour Comm. Bldg., Toronto, $86,309.

Ont., Port Maitland—Dpt. P. Wks., N. Desjardins, secy., Ottawa harbor improvements to Wm. Benningham & Son, Kingston, $12,744.

Bond Elections

Coming Bond Elections

Waterworks—Salem, Ore., Nov. 30, $2,500,000.
Schools, etc.—Oil City, Pa., $455,000.

Bonds Voted

Sewers, etc.—Rapid City, S. D., $215,000. H. W. Zolper, city engr. A. A. Chenoweth, Sioux Falls, consult. engr.
Flood Control—Sacramento, Calif., $565,000. A. M. Barton, North Sacramento, engr.
Light and Power Plant—Remsen, Ia., $75,000.
Gas System—Memphis, Tenn., $65,000.

Bonds Defeated

Waterworks, etc.—Waverly, Mo., $45,000.
Power Plant, etc.—Le Mars, Ia., $325,000.

FEDERAL GOVERNMENT

PROPOSED WORK

Calif., San Francisco—DOCK EXTENSION—Con. O.M. Fort Mason, rein.-con. extension to Dock 3, Fort Mason. $200,000.

Calif., San Francisco—WARD BUILDINGS—Con. Q.M., Fort Mason, two 2 story, brick, rein.-con. ward buildings at Letterman General Hospital, S. F. Presidio. $200,000.

Calif., San Francisco—WAREHOUSE—Con. Q.M., Fort Mason, 5 story, 11 x 450 ft. rein.-con., Presidio.

D. C., Wash—STORAGE—U. S. Eng. 1 steel storage and 1 steel shop buildings, 11th and O Sts. S.E., exclusive of found. and brook end walls to be built under separate contracts.

Florida—DREDGING—U. S. Eng., Jacksonville, 525,000 cu.yd. from relocation cut in Intracoastal Waterway, near Matanzas Inlet.

Ill., Chicago—ELECTRIC EQUIPMENT—U. S. Eng., installing lock electric equipment at Lockport Marseilles and Starved Rock Locks on Inland Waterway.

Ky., Lexington—NARCOTIC FARM—Dpt. Justice, Bureau Prisons, plans by Treas. Dpt. at office Sup. Archt., narcotic farms.

Massachusetts—EXCAVATING—U. S. Eng., Providence, R. I., rock excavating in Taunton River between Taunton and Dighton. $25,000 or more.

Mass., Rockland—POST OFFICE—Treas. Dpt. at office Sup. Archt., plans by J. W. Beal Sons, 185 Devonshire St., Boston, 1 story, basement, brick, steel, Webster and Park Sts. $115,000. Noted Aug. 19.

Minn., Rochester—POST OFFICE—Treas. Dpt. at office Sup. Archt., rein.-con., stone post office. $300,000.

Tenn., Jackson—POST OFFICE—Treas. Dpt. at office Sup. Archt., rein.-con., brick, stone, market and Shannon Sts. $350,000.

Texas and Oklahoma—AIRWAY LIGHTING—Dpt. Commerce bids in November 343 mi. airway lighting between Amarillo, Tex., and Tulsa, Okla., via Oklahoma City. C. H. Horan, c/o owner, engr.

Federal Government (Continued)

Tex., Fort Worth—NARCOTIC HOSPITAL—Dpt. Justice, Bureau Prisons, plans by Treas. Dpt. at office Sup. Archt., narcotic hospital, $4,000,000.

Tex., Mercedes — LABORATORY — Bureau Chemistry and Soils, citrus by-products laboratory.

W. Va., Huntington—TWIN LOCKS—U. S. Eng., twin locks on Marmet Site, Great Kanawha River, incl. 300,000 cu.yd. concrete, 440,000 lb. structural steel, 373,000 lb. steel castings, 47,000 cu.yd. excav., 27,000 cu.yd., fill, 117,000 B.M. timber oak, 48,000 B.M. pine timber, 1 power house, 1 lot valve operating machinery, 1 lot gate operating machinery.

BIDS ASKED

Ala., Fort McClellan—GARAGE, etc.—Oct. 12, by Con. K.M., 1 garage, utilities.

Ala., Greenville—POST OFFICE—Oct. 12, by Treas. Dpt. at office Sup. Archt., U. S. Post Office; adv. E.N.-R., Sept. 24.

Ark., North Little Rock—CLINICAL BUILDING—Oct. 20, by Con. Q.M., clinical building.

Conn., Manchester—POST OFFICE—Treas. Dept. at office Sup. Archt., bids about Oct. 1, general contract 1 story, basement, brick, stone $135,000. Noted Aug. 6.

D. C., Wash.—LIGHTING—Oct. 15, at office Pub. Rds., lighting Roaches Run, Unit V Mount Vernon Memorial Hy.; adv. E.N.-R. Sept. 24.

D. C., Wash.—SUPREME COURT—Oct. 21, at office D. Lynn, archt. Capitol, 5 story, basement central portion, 3 story, basement side portions, marble supreme court building, incl. terraces, driveways. $9,000,000. Noted July 16.

Idaho, Boise—DISTRIBUTING SYSTEM—Sept. 30, by Vet. Bureau, extending Dulside steam distributing system, incl. two 100 hp. boilers, clay pipe conduits, 2 portable fire box boilers, stokers, blowers, pumps and blowoff lines, at U. S. Veterans Hospital.

Ill., Chicago—STEEL PILING—Sept. 25, by U. S. Eng., 1st Chicago Dist., 333 North Michigan Ave., steel piling for Kampsville and LaGrange Cofferdams.

Ill., Chicago—SIGNAL CABLE, etc.—Sept. 30, by Superintendent Lighthouses, 12th Dist., 424 Federal Bldg., Milwaukee, Wis., submarine electric cables for installation by U. S. in Carter Harrison Crib Tunnel, incl. 15,000 ft. signal cable, 15,000 ft., 4,000-volt power cable.

Ia., Knoxville—WATER SOFTENING PLANT—Oct. 6, by Vet. Bu., Arlington Bldg., Zeolite water softening system at U. S. Veterans Hospital.

La., New Orleans—BULKHEADS—Oct. 1, by Superintendent Lighthouses, New Orleans, 610 ft. creosoted pile, timber bulkheads.

Mass., Hingham—RAILROAD TRACK—Spec. 6636—Sept. 28, by Dist. P. Wks. Officer, Navy Yard, repairing railroad track.

Missouri — CLUMP DIKES — Sept. 30, by U. S. Eng., 428 Customhouse, St. Louis, 2,500 lin.ft. standard pile clump dikes and 700 lin.ft. crib dikes in Missouri River, at Hinkles Bed between Miles 64 and 66, above the mouth; adv. E.N.-R. Sept. 24.

Nev., Boulder City—PURIFICATION PLANT, etc.—Oct. 5, by Bureau Reclamation, Las Vegas, water purification plant and sewage disposal plant.

N. Y., Brooklyn—CABLE—Sept. 29, by Signal Supply Officer, Army Base, 58th St. and 1st Ave., cable.

N. Y., Brooklyn—FIRE ALARM SYSTEM—Oct. 12, by Treas. Dpt. at office Sup. Archt., fire alarm system at extension 1929, U. S. Post Office, Court House; adv. E.N.-R. Sept. 24.

Pa., Phila—PIER, etc.—Spec. 6654—Sept. 30 (extended date), by Yards & Docks, Navy Dpt., removing pier and dredging at Navy Yard. Noted Sept. 17.

Va., Welkins—EXTENSION, etc.—Oct. 14, by Treas. Dpt. at office Sup. Archt., extending, remodeling U. S. Post Office, Court House; adv. E.N.-R. Sept. 24.

Va., Langley Field—QUARTERS—Oct. 6, by Con. Q.M. 6 single company officers and 4 double company quarters. $50,000.

T. H., Wheeler Field—HANGARS—Oct. 15, by Con. Q.M. Fort Shafter, Honolulu, 4 air corps hangars, machine shop, warehouse and assembly building. $500,000.

Canal Zone—HANGARS—Nov. 24, at office Dpt. Quartermaster, Quarry Heights, erecting, completing 3 air corps hangars (double); 1-A. completing 3 air corps hangars (double); 1-A. C. warehouse and 1 air corps machine shop at Albrook Field; adv. E.N.R. Sept. 24.

CONTRACTS AWARDED

Ala., Montgomery—TANK—Con. Q.M., Maxwell Field, 300,000 gal. steel tank on 100 ft. trestle at Maxwell Field, to Chicago Bridge & Iron Wks., Birmingham, $15,435. Noted June 25.

Ala., Sylacauga—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to A. J. Honeycutt Co., Birmingham, $57,500.

Arkansas—OFFICE—U. S. Eng., McCall Bldg., Memphis, Tenn., office building at site of U. S. Supply and Repair Depot, on west bank of Mississippi River opposite Memphis, Tenn., to J. H. Reddick, Fort Smith, $166,824. Noted Sept. 3.

California—ROAD—C. H. Sweetser, dist. engr. Pub. Rds., 461 Market St., San Francisco, grading Generals Hy., General Grant Natl. Park, to Bodenhamer Constr. Co., Oakland, $62,703. Noted June 18.

California — ROAD — C. H. Sweetser, dist. engr. Pub. Rd., 461 Market St., San Francisco, improving Morgan Summit-Morgan Springs Natl. Forest Hy., Lassen Natl. Forest, to W. C. Colley, Berkeley, $70,662; Deer Creek Natl. Forest Hy., to Baker & Taylor, Bieber, $87,795. Noted July 2.

Conn., New Haven—DREDGING—U. S. Eng., Providence, R. I., 150,000 cu.yd. material from Bowery St. to Morris & Cummings Dredging Co., 44 Whitehall St., New York. Est. $25,000. Noted Aug. 20.

Conn., Newington—RECREATION BUILDING—Vet. Bureau, Arlington Bldg., rein.-con., brick, steel, terra cotta, at U. S. Veterans Hospital, to D. A. Sullivan & Sons, 78 Main St., Northampton, Mass., $118,797. Est. $170,000.

Ga., Atlanta—POST OFFICE—Treas. Dpt. at office Sup. Archt., tunnel, found. for U. S. Post Office, to National Constr. Co., Tower Bldg., Wash., D. C., $249,000. Noted July 16.

Ga., Madison—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to Norwood-Griffin Co., Atlanta, $39,995. Noted June 25.

Ill., Joliet—WALLS—U. S. Eng., 1st Chicago Dist., 333 North Michigan Ave., Chicago, constructing masonry walls thru here on Des Plaines River, to Green & Sons Co., 6 North Michigan Ave., Chicago, $448,198. Noted Aug. 19.

Ia., Cedar Rapids—ELEVATORS—Treas. Dpt. at office Sup. Archt., elevators for U. S. Post Office, to Heller Elevator Co., 250 Milwaukee St., Wis., $21,345. Noted Sept. 17.

Ia., Centerville—POST OFFICE—Treas. Dpt. at office Sup. Archt., remodeling, enlarging 32 x 56 ft. concrete, brick, to C. Weitz Sons, Inc., 713 Mulberry St., Des Moines, $15,853. Noted Aug. 6.

La., New Orleans — EARTHWORK — U. S. Eng. Prytania St., to Acme Constr. Co., Pointe a la Hache, 285,000 cu.yd. earthwork in Providence New Levee, LaFourche Levee Dist. $26,790. 180,000 cu.yd. LaReusite-Alliance Levee $16,920, and 130,000 cu.yd. Junior-Point Cleste Levee, new, $12,220; both Barataria Levee Dist.; to Valley Constr. Co., Newellton, Esparance Levee, new, in Lower Tensas Levee Dist., 2nd Orleans Dist. Item R715, 725,000 cu.yd. each in Item A to D (inclusive) $459,650. Grand total $515,580. Noted Aug. 20.

Me., Eustis—INSPECTION STATION—Treas. Dpt. at office Sup. Archt., U. S. Post Office to United Constr. Co., Pawtucket, R. I., $42,303. Noted Aug. 27.

N. J., Trenton—POST OFFICE, etc.—Treas. Dpt. at office Sup. Archt., U. S. Post Office and Court House, to Karno-Smith Co., Broad St. Bank, $749,500. Noted July 30.

N. Y., New York—ELEVATORS—Treas. Dpt. at office Sup. Archt., elevators for U. S. Parcels Post Building, to Westinghouse Electric Elevator Co., 150 Bway., $248,735. Noted Sept. 10.

N. C., Rutherford—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to A. Perry, Jr., Bisbee Bldg., Jacksonville, Fla., $46,680. Noted Aug. 13.

Oregon — BRIDGES — Pub. Rds., Portland, bridges over Rogue River, near Agnes to Clackamas Constr. Co., Oregon City, $21,885. Noted Sept. 3.

R. I., Pawtucket—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to E. S. Moore & Son, 610 North Washington St., Kokomo, Ind. $209,700. Noted Aug. 20.

Tenn., Memphis—DREDGING—U. S. Eng., McCall Bldg., 1,045,000 cu.yd. earthwork in White River Levee Dist., to Kochtitzky & Johnson, Inc., P. O. Box 4, Forrest City, Ark., $198,550. Noted Aug. 19.

Tex., El Paso — PRISON — Bureau Prisons, Dpt. Justice, structural steel for federal prison, to Ingals Iron Wks., Dallas; reinforcing steel, to Darbyshire-Harvie Iron Wks., Dallas; 2 elevators, metal doors, to C. C. Gaines, 1st Natl. Bank Bldg., El Paso. Noted Aug. 6, under "Contracts Awarded."

Texas and Louisiana — DREDGING — U. S. Eng., Galveston, Tex., 37,000 cu.yd. entrance channel from Sabine Lake to Johnons Bayou, to Gulf Coast Dredging Co., 2311½ C St., Galveston, Tex., at $0.20 per cu.yd. Noted Aug. 12.

Tex., Randolph Field—PIPES, etc.—Con. Q.M. supplying pipes, fittings for equipment to move gasoline from 2 main underground storage tanks, near hangar here and from these tanks to delivery point along flying line, to Standard Sanitary Plumbing Co., Bway. and Jones Ave., San Antonio. Noted Aug. 20.

Va., Langley Field—DRAINAGE SYSTEM—Con. Q.M. Langley Field, storm water drainage system for hangar and barrack areas, to A. G. Pinkston Constr. Co., Essex Bldg., Norfolk, $33,980. Noted Aug. 20.

Utah, Idaho and Oregon—LANDING FIELDS—U. S. Airways, Dpt. Commerce, Boston Bldg., Salt Lake City, Utah, emergency landing fields at Locomotive Springs, Utah, Jerome, Mountain Home and Weiser, Idaho, and Meacham, Ore., on Salt Lake-Pasco Airway to Peler Tonneson & Hunt, Salt Lake City, Utah, $4,325. Est. $6,000. Noted Aug. 12.

Washington—EARTHWORK—Bureau Reclamation, Ellenburg, construction, equipment for North Branch Canal Lateral System, Wippel Pump, gravity and turbine laterals, Kittitas Div., Yakima Project, to J. A. Terteling & Son, Moscow, Idaho, $133,397. Noted July 30.

Wis., Milwaukee—BARRACKS, etc.—Vet. Bu., Arlington Bldg., barracks, dining hall at U. S. Natl. Soldiers Home, to W. M. Christensen, 1421 West 6th St., Racine, $239,243. Noted Aug. 13.

RAILWAYS

PROPOSED WORK

California—Belt Ry. Co., Park and Dearborn Sts., Chicago, Ill., F. E. Morrow, ch. engr., belt-line railroad in connection with deep water project, in Stockton. To exceed $25,000.

Texas—Waco, Beaumont, Trinity & Sabine Ry. Co., P. G. Burns, ch. engr., San Antonio, acquired all rolling stock and trackage of Eastern Texas Elec. Co. and plan rebuilding line. Est. $1,500,000. Total est. $2,000,000. Interested dealers and contractors should communicate with owner at once.

GRADE CROSSINGS

PROPOSED WORK

N. Y., Croton Falls—New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, bids latter part November reconstructing bridge over County Hy. 775, 0.5 mi. north of here, Westchester Co. $175,000.

N. Y., Port Henry—Delaware & Hudson R.R. Co., J. MacMartin, ch. engr., Albany, eliminating Port Henry-Westport Hy. Crossing, 5 mi. north of here. $90,700.

N. Y., Valhalla—New York Central R. R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, soon takes bids granite masonry and culvert over Davis Brook, as part of eliminating railroad grade crossing, 200 ft. north of Valhalla station. $175,000.

N. Y., Whitehall—Delaware & Hudson R.R. Co., J. MacMartin, ch. engr., Albany, eliminating grade crossings and track and bridge reconstruction over canal. $1,367,500. State Dpt. P. Wks. approved plans. Noted Sept. 11.

Pa., Erie—City Council bids early in 1932, subway under railroad at Cranberry St. $375,000. A. N. Aitken, City Hall, engr. Noted Feb. 5.

Ont., East Windsor—Town, concrete and rein.-con. or concrete and structural steel subway under Canadian Natl. Ry., George Ave. $100,000. H. W. Patterson, Imperial Bldg., Walkerville, engr.

BIDS ASKED

New York—Oct. 5, by Westchester Co. Park Comn., 72 West Pondfield Rd., Bronxville, overcrossing at Tarrytown Rd., Eastview on Saw Mill River Parkway, in Greenburgh and Mount Pleasant, Contr. 382, J. Downer, Bronxville, ch. engr.; adv. E.N.-R., Sept. 24.

Pa., Glenshaw—A. C. Clark, assistant ch. engr., Maloney Bldg., Pittsburgh, taking bids (selected list of contractors) excavation for Witmer-Mt. Royal Grade Crossing, incl. 300,000 cu.yd. excav relocating main tracks of railroad for 1.5 mi., near here for Allegheny Co., Pittsburgh, R. G. Woodside, controller, State Hy. Dpt., Harrisburg, S. S. Lewis, ch. engr., and Baltimore & Ohio R. R. Co., Baltimore, Md., H. A. Lane, ch. engr. Total est. $900,000. Noted July 9.

Que., Vaudreuil—Sept. 25, by T. T. Irving, ch. engr. (Central Region) Canadian Natl. Rys., Union Sta., Toronto, Ont., concrete subway under Canadian National Railways at new provincial hy. (Petite Cote Rd.), near here.

CONTRACTS AWARDED

Ky., Bellevue—Chesapeake & Ohio R.R. Co., Richmond, Va., C. W. Johns, ch. engr., undergrade crossing, to Walsh Constr. Co., 1206 New City Trust Bldg., Indianapolis, Ind., $100,000.

N. Y., Harrisville—New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, substructure and superstruecutre for eliminating State Street Crossing, Lewis Co., to N. D. Peters & Co., Inc., Utica, $22,924. Est. $24,267. Noted Aug. 20.

N. Y., Sherman—Pennsylvania R.R. Co., T. J. Skillman, ch. engr., Broad St. Sta., Phila., Pa., eliminating Hitcomb, Shreve and Osborne St. Grade Crossings, to Ferguson & Edmundson, Keystone Bldg., Pittsburgh, Pa. $35,646.

Ont., Welland—Toronto, Hamilton & Buffalo, R.R., R. L. Latham, Hamilton, ch. engr., underpass to carry King's Hy. 20 under railroad tracks at point 9 mi. from here, to Dominion Constr. Co. Ltd., Reford Bldg., Toronto. Greater part of cost to be borne by Province of Ontario.

DAMS

CONTRACTS AWARDED

Pa., Ridgeway—See "Water Works."

PIERS AND WHARVES

CONTRACTS AWARDED

Mass., Provincetown—WHARF—Town Bd. Selectmen, reconstructing timber piling town wharf, to F. M. Jacobs & T. A. Francis, Provincetown. Est. $25,000.

Ont., Chatham — WHARF — Dpt. P. Wks., Ottawa, wharf reconstruction, to Chatham Dredging & Contg. Co., Chatham, $84,000.

Ont., Parry Sound—WHARF—Dpt. P. Wks., Parliament Bldgs., Ottawa, reconstructing 505 lin. ft. timber and crib wharf, to Chatham Dredging & General Contg. Co., 96 King St. W., Chatham. Est. $85,000.

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AIRPORTS

BIDS ASKED

Mass., Boston—J. M. Curley, mayor, announced bids will be opened Oct. 6, 2,600,000 cu.yd. filling, bulkhead extensions and repairs, constructing hydroplane basin; 4,000 ft. circumference, at Boston Airport. $750,000.

GRAIN ELEVATORS

BIDS ASKED

N. Y., Albany—Oct. 3, at office Albany Port District Comn., 74 Chapel St., grain elevator and warehouse. $1,500,000. A. G. Chapman, ch. engr. Noted Aug. 20.

CONTRACTS AWARDED

Kan., Emporia — GRAIN ELEVATOR — Emporia Elevator & Feeding Co., 26 x 30 ft. grain elevator, 60 ft. high, concrete, 15,000 bu. capacity, to Federal Eng. Co., 216 West 6th St., Topeka. Est. $10,000. H. Smith, lessee.

Kan., Lawrence — GRAIN ELEVATOR — Bowersock Milling Co., has work underway 100,000 bu. grain elevator. Owner builds.

Wis., Manitowoc — GRAIN ELEVATOR — Cereal Products Co., 605 Washington St., 500,000 bu. grain elevator, to McKenzie-Hauge Co., Corn Exch. Bldg., Minneapolis, Minn.

POWER AND LIGHTING

PROPOSED WORK

Okla., Bretton—City voted franchise to Western Serv. Corp., Braniff Bldg., Oklahoma City, natural gas system. $40,000. Private plans. Noted Aug. 27.

Tex., Wellington—City municipal natural gas distributing system, 50,000 lin.ft. 2- to 6-in. pipe. $65,000 voted for same. Address Mayor. Noted June 4.

Que., St. Lamberts—Montreal Light, Heat & Power Co., 107 Craig St. W., Montreal, gas mains to supply city. $500,000.

BIDS ASKED

Ind., Albion—Sept. 28, by City, 50 street lighting standards, 36 extra units, street standards, 8,000 ft. 8-3 wire, 600 volt Parkway cable. F. W. Foote, city clk.

CONTRACTS AWARDED

New Hampshire—New Hampshire Pub. Serv. Co., Manchester, gas pipe line from Laconia to Franklin via Belmont, Sanborton, Tilton and Northfield, incl. 14 mi. 4 in. 15 mi. 2 in., and 8 mi. 1½ in. pipe; to Hugh Nawn, Inc., 295 Columbia Rd., Dorchester, Mass. Est. $150,000. Noted July 2.

New York—Westchester Co. Park Comn., 72 West Pondfield Rd., Bronxville, electric lighting system on 9.72 mi. Bronx Parkway extension from Croton Lake to Bear Mountain Bridge Rd., Contr. 372, to J. Sugden, 67 West 44th St., New York. $43,011. Noted Aug. 20.

PARKS AND SPORTS

PROPOSED WORK

Mass., Boston—City of Boston, Park Dpt., public playground, Perle St. adjacent to Rogers Park, Brighton. $25,000 or more.

Mass., Chatham—Town, Bd. Selectmen, soon takes bids 2 story, timber gymnasium, school addition, Main St. $25,000 or more. McLaughlin & Burr, 88 Tremont St., Boston, archts. Noted Aug. 6.

Mass., Springfield—City Dpt. Parks, City Hall, concrete swimming pool. $25,000.

N. Y., Brooklyn—Young Israel Synagogue, 50th St. and 14th Ave., swimming pool and bath. $40,000 Project in abeyance. Slee & Bryson, 16 Court St., archts. Noted Aug. 6.

Vt., Middlebury—Middlebury College, P. Moody, in charge, indoor playing field. $100,000. Coolidge & Carlson, 89 State St., Boston, Mass., archts.

Ont., Sudbury—City expending $68,095 grading, preparing athletic park, incl. 11,600 cu.yd. rock removal, est. $40,600, and graveling $10,086, together with earth grading, sodding, etc. W. McMullen, Mackie Bldg., engr.

Ont., Toronto—See "Excavation, Drainage, Irrigation, Levees, Rivers and Harbors."

BIDS ASKED

Fla., Coral Gables (br. Miami)—See "Contracts Awarded."

N. J., North Long Branch—H. I. Braun, archt., 191 Bway, Long Branch, bids about Nov. 1, general contract 1 story, basement, brick, steel bathing pavilion, Ocean Ave., for S. A. McNair, 388 Ocean Ave., Long Branch. $200,000. Noted July 16.

Ont., Toronto—See "Contracts Awarded."

CONTRACTS AWARDED

Fla., Coral Gables (br. Miami)—Miami Biltmore Hotel & Country Club, c/o H. L. Doherty, 66 Wall St., New York, golf course, sports development, day labor and separate contracts. To exceed $60,000.

Me., Wilton—Town, E. H. Morrison, Wilton Trust Co., regulation golf course. Owner builds. Stiles & Van Kleek, 97A Newbury St., Boston, Mass., engrs. Noted Sept. 10.

Mass., Beverly—City, concrete bleachers, high school athletic field, to Pitman & Brown Co., 11 Washington St., Salem. Est. $25,000.

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Mass., Boston — City, Park Dpt., concrete bleachers, grading, Healy Playground, Roslindale, to Guarantee Constr. Co., 161 Harvard St., Allston. Est. $25,000.

Mass., Wilbrahm—Wilbrahm Academy, R. E. Peck, master, erecting field house at Corbin Field for athletics, to A. Ammann, 604 North Main St., Palmer.

O., Cleveland—City, D. E. Morgan, mgr., two 1 story, basement, brick, steel, concrete, swimming pools, Cortland and Duthwaite Ave., to Aronberg-Fried Co., Inc., Midland Bank Bldg., $197,600; steam heating, to Warden & Leese, 2751 Prospect Ave. Noted Aug. 13.

Vt., Montpelier—Montpelier Seminary, 1 story, brick, timber, gymnasium at seminary, to C. M. Dinwell Co., School St., Orleans. Est. $25,000.

Ont., Toronto—City, Parks Dpt., grading and sodding at High Park, $41,000; Lake Shore Park, $37,000; Glen Stewart Park, $5,200; East Lynn Park, $10,000; at St. Clair Ave. Reservoir, $25,000; filling field house at Lytton Park, $3,200 and $5,000 respectively; field house Cottingham Square, $7,500; Withrow Park, $7,500; Perth Square, $2,000; bathing station, Kippendavie Ave., $20,000; lavatory, Woodbine Beach, $12,000; grading at Riverdale Park, $17,000; restoring grounds, Old Fort, $15,000; bathing station, Hanlans Point, $20,000; Centre Island, $20,000. Most of work by day labor as unemployment relief. R. C. Harris, City Hall, engr.

HEATING AND VENTILATING

BIDS ASKED

N. Y., Jamaica—Oct. 1, by W. C. Martin, archt. and supt. School Buildings, Flatbush Ave. extension and Concord St., Brooklyn, heating, ventilating, plumbing, drainage, electrical lighting for additions to P. S. 117, 84th Dr., 143rd and 144th Sts., for Bd. Educ., 500 Park Ave.

N. Y., Whitestone—Oct. 1, by W. C. Martin, archt. and supt. School Buildings, Flatbush Ave. extension and Concord St., Brooklyn, heating, ventilating, plumbing, drainage, P. S. 79, 15th Dr., 15th Rd., 147th and 149th Sts., for Bd. Educ., 500 Park Ave., New York.

CONTRACTS AWARDED

N. Y., Annadale (sta. Staten Island)—Bd. Educ., 500 Park Ave., New York, heating P. S. 36, to Harry Starkman & Bros., 132 Brook Ave., New York, $34,660; plumbing, to J. F. Egan Co., 127 West 20th St., New York, $15,393; electrical work, to Yarmark Electric Equipment Co., 305 Bway, New York, $10,580. Grand total $60,633. Noted July 23.

N. Y., Hollis—Bd. Educ., 500 Park Ave., New York, heating P. S. 118, to D. J. Rice, Inc., 41-50 38th St., Long Island City, $34,400; plumbing, to G. D. Capper, Inc., $12,800; electrical work, to Oxford Contg. Co., 1440 Bway, New York, $10,669. Grand total $57,869. Noted Aug. 6.

Pa., Phila.—Pennsylvania R.R. Co., Broad St. Sta., heating, ventilating, plumbing for 3 story, basement, 172 x 327 ft. rein.-con., limestone station, 30th and Market Sts., to W. G. Cornell, 1321 Arch St.; electric wiring, to Riggs Distler Co., 1518 Walnut St. Noted June 19, under "Buildings—Unclassified."

UNCLASSIFIED

PROPOSED WORK

N. Y., New York—COKE POCKETS, etc.—Consolidated Gas Co., 4 Irving Pl., plans by J. H. Hunter, c/o owner, 2 coke pockets, 427 East 110th St., $30,000; and 1 story, 35 x 141 ft. brick pump house and tar separating pit, Bronx River, Hunts Point and Bayview Aves., $50,000.

Texas—PIPE LINE—Philips Petroleum Co., Bartlesville, Okla., 25 mi. 3 in. welded pipe line from Crane City to McCamey; constructing loading racks at McCamey. $150,000. Private plans.

Tex., Beaumont—BAKING OVENS—Fehr Baking Co., 4104 Leeland St., installing baking ovens in plant. $40,000. Private plans.

Ont., Fort William—GAS PLANT—Hamilton By Product Coke Ovens Ltd., 15 Main St. E., Hamilton, gas plant. $1,500,000. Council approved agreement and ratepayers will vote Oct. 17 on proposal to construct. Noted July 31, 1930.

Ont., Windsor—BROADCASTING STATION—M. G. Campbell, 156 Sandwich St. E., Sandwich, interested in company which plans to erect and equip broadcasting station, near here. $70,000.

BIDS ASKED

N. J., Jersey City—COAL POCKET—W. Neuman, archt., 26 Journal Sq., taking bids 1 story, brick, rein.-con., for New Jersey Coal Co., 374 Newark Ave. $40,000.

N. J., Newark—CINDER HANDLING PLANT—See "Contracts Awarded."

N. Y., Attica—REFRIGERATION WORK—Oct. 6, by Commissioner Dpt. Correction, State Office Bldg., Albany, refrigeration work, storehouse, maintenance building, at Attica State Prison.

N. Y., Johnstown—FIRE SPRINKLERS—Oct. 9, by Commissioner Conservation Dpt., State Office Bldg., Albany, automatic fire sprinklers, Sir William Johnson Mansion; adv. E.N.-R., Sept. 24.

N. Y., Kingston—TIMBER PILING—Sept. by Adjutant General, Div., Military & Naval Affairs, Capitol, Albany, timber piling for State Armory; adv. E. N.-R. Sept. 24.

N. Y., Middletown — REFRIGERATION — Oct. 7, by Dpt. Mental Hygiene, State Office Bldg., Albany, refrigeration work, additions, alterations Ashley Hall, Middletown State Hospital; adv. E.N.-R., Sept. 24.

N. Y., New York—STATION FINISH—Oct. 2, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., completing construction and station finish Routes 78, 101, 102 and 105, Fulton to 207th Sts., Agreement "LE."

Pa., Phila., ESCALATORS, etc.—Oct. 5, by Dpt. City Transit, City Hall Annex, C. H. Myers, dir., Contr. 320—escalators at 8th and Market Sts., and in City Hall Court Yard and Market St. Subway; Contr. 324, underground cable system, subway distribution cables, subway station tunnel and concourse, lighting and power systems, City Hall Concourse and West Philadelphia Branch—Broad St. Subway.

Utah, Logan—GREENHOUSES, BOILERS, etc. Sept. 29, by State Building Comn., State Capitol, Salt Lake City, furnishing, installing boiler, stoker, constructing 2 greenhouses at State Agricultural College. R. K. Brown, c/o owner, engr.

CONTRACTS AWARDED

Ind., Indianapolis—WAR MEMORIAL—Indiana World War Memorial, American Legion Bldg., 777 North Meridian St., interior work main shrine, incl. one 600 and two 200 seating capacity each auditoriums, marble will come from Tennessee, Vermont, also 20% imported from Italy, Greece, Africa and Sweden, to Moynaham Constr. Co., 710 Union Title Co., $1,058,753. Noted Sept. 10.

Mass., Boston—COAL DISTRIBUTING STATION—New England Fuel & Transportation Co., 250 Stuart St., coal distribution station, Locust St., South Boston, to A. G. Tomaselli & Son., Inc., 250 Stuart St., $50,000.

Mass., Walpole—MEMORIAL—Town, H. C. Caldwell, chn. building comn., 1 story, brick, stone, memorial, Kendall St., to F. J. Tetreault & Co., 252 Common St., $43,961. Est. $50,000.

N. J., Newark—CINDER HANDLING PLANT—Lehigh Valley R.R. Co., G. T. Hand, ch. engr., 145 Liberty St., New York, 1 story cinder handling plant, brick, steel, incl. 42 ft. square tower and funnel, sand conveyors, Oak Island west of Bay Ave., separate contracts. $40,000.

N. J., Sea Girt—BOARDWALK—City Council, boardwalk, to T. Proctor Co., Long Branch, $23,978. Noted Aug. 19.

N. Y., Port Richmond—FIELD HOUSE—Port of New York Authority, 80-90 8th Ave., New York, general contract field house for Kill Van Kull Bridge, to Auf-der Heide Co., 530 Jackson Ave., West New York, N. J., $42,230: heating, to R. W. Baylor, 9 Sommers Pl., West New Brighton, $5,589; electrical work, to J. C. Morris, Inc., 26 Journal Sq., Jersey City, $1,407; plumbing, to Competent Plumbing & Heating Co., 288 Bway., West New Brighton, $1,940. Grand total $51,166.

Oklahoma and Indiana—PIPE LINES—Standolind Pipe Line Co., c/o Standard Oil Co. of Indiana, 137 West 11th St., Indianapolis, Ind., 135 mi. additional loops along trunk line from Healdton, Okla., to Whiting, Ind., to Ford, Bacon & Davis, 39 Bway, New York; 35,000 tons 8- to 12-in steel pipe, to A. O. Smith Corp., 27th and Keefe Sts., Milwaukee, Wis., to Youngstown Sheet & Tube Co., Poland Ave., Youngstown, O., to Republic Steel Corp., 60 East 42nd St., New York, to Spang Chalfant & Co., 51 East 42nd St., New York, and to National Tube Co., 71 Bway, New York.

Texas — PIPE LINE WELDING — Texas-Empire Pipe Line Co., Port Arthur, electric welding 120 mi. 12 in. line being constructed between Gladewater and Port Arthur, to Welding Eng. Co., Bartlesville, Okla., $90,000. Noted Aug. 20.

MATERIALS

BIDS ASKED

POWER EQUIPMENT—**Walnut, Ia.**—Oct. 6, by City, H. P. Roll, clk., 275 to 375 hp. vertical, multi-cylinder full Diesel engine generator unit and generator of corresponding size, 2-phase, 60 cycle, 2,400 volt direct connected type with exciter, removing 40 ft. wall of engine room, exhaust pit with connecting pipe, exhaust stack not less than 40 ft. high, pyrometer with adequate switch for registering exhaust temperatures of each cylinder, lubricating oil circulating equipment with pump and filter, motor driven air compressor, auxiliary fuel tank, fuel, oil, air and water piping, changes in cooling system, incl. 400 hp. cooling tower over reservoir, 200 g.p.m. motor driven pump unit, 6 panel switchboards.

PORTLAND CEMENT—**Brooklyn, N. Y.**—Sept. 30, by H. Hesterberg, pres. Brooklyn Boro, Boro Hall, 1,000 bbl. portland cement; 10,000 cu.yd. steam cinders, 400,000 gal. asphaltic cement for sheet asphalt and bituminous concrete mixtures B in liquid form; 1,200 net tons limestone and other suitable inorganic dust; 15,000 cu.yd. asphalt sand; 3,000 cu.yd. binder stone.

FIREALARM POSTS, etc.—**New York, N. Y.**—Oct. 2, by P. J. Dooling, comr. Purchase, Municipal Bldg., fire alarm posts and terminal boxes.

Materials (Continued)

PINE PILES—New York, N. Y.—Sept. 30, by P. J. Dooling, comr. Purchase. Municipal Bldg., oak and yellow pine piles to Dpt. Docks.

ASPHALTIC MACADAM BINDER—St. George, N. Y.—Sept. 30, by J. A. Lynch, pres. Richmond Boro, Boro Hall, 62,000 gal. asphaltic macadam binder, hot application, on streets as directed.

ELECTRICAL ADJUNCTS, BLOCK SIGNALS, etc. — Pittsburgh, Pa.—Sept. 30, by J. H. James, purch. agt., Pittsburgh & Lake R.R. Co., 222 Pennsylvania & Erie Terminal Bldg., requirements for 1 year and thereafter until cancelled by 90 days notice, all materials for installation and maintenance and repair of mechanical interlocking plants, electrical adjuncts, electric-pneumatic and electric lockings, automatic block signals, centralized traffic control and car retarder systems, automatic train control, highway crossing signals and similar appurtenances manufactured by the Seller, covered by Serial Contr. 4, 1931.

WATER PIPE—Vancouver, B. C.—C. Brakenridge, city engr., wants prices, 15,000 ft. 8 in., 30,000 ft. 6 in. and 1,000 ft. 4 in. water pipe.

CONTRACTS AWARDED

CEDAR POLES—Redding, Calif.—L. Engram, city clk., thirty 45 ft. and thirty 40 ft. cedar power poles, 9 in. top, to Niedermeyer-Martin Lumber Co., Spalding Bldg., Portland, Oregon, at $13.46 and $11.12 each respectively. Noted Aug. 27.

CAST IRON PIPE—Dearborn, Mich.—City, 1,700 lin.ft. 6 in. and 8,700 ft. 8 in. c.i. water pipe, to American Cast Iron Pipe Co., 2930 North 16th St., Birmingham, Ala., at $0.555 and $0.78 per ft. respectively, total $16,225.

STEEL PIPE, etc.—Minneapolis, Minn.—F. S. Gram, city purch. agt., to East Orange Pipe Co., 7 Dey St., New York, 771 ft. 60 x 7-16 in. lock-bar type pipe and fittings, at $20.90 per ft., 977 ft., 60 x ⅜ in. at $14.28, 217 ft. 50 x ⅜ in. $18.45, above pipe to be laid under Mississippi River. Noted Aug. 27.

BITUMINOUS CONCRETE—St. George, N. Y.—J. A. Lynch, pres. Richmond Boro. Boro Hall, 500 tons bituminous concrete in Dists. 1, 2 and 3, to Vanbro Constr. Co., 24 Elizabeth St., West New Brighton, $7,475.

WOOD PAVING BLOCKS—New York, N. Y.—P. J. Dooling, comr. Purchase. Municipal Bldg., wood paving blocks to Dpt. Plant & Structures, to Southern Wood Preserving Co., 10 East 43rd St., New York, $6,300. Noted Aug. 12.

BROKEN STONE, etc.—St. George, N. Y.—J. A. Lynch, pres. Richmond Boro, Boro Hall, 500 cu.yd. broken stone and chips and 1,500 cu.yd. stone and chips, to Vanbro Constr. Co., 24 Elizabeth St., West New Brighton, $1,750 and $5,670 respectively. Noted Aug. 19.

PIPE — Oklahoma and Indiana — See "Unclassified."

WATER METERS, etc.—Pittsburgh, Pa.—City, City-County Bldg., water meters for city and consumers, repairing, replacing parts for meters in use, to Pittsburgh Equitable Meter Co., 400 Lexington Ave., $100,000.

PIPE—Howard, R. I.—State Purchasing agent, P. Welfare Dpt., State House, Providence, furnishing c.i. bell and spigot pipe and fittings, to Rhode Island Supply & Sprinkler Co., 156 West Exchange St., Providence, $3,357. Noted Aug. 20.

FERTILIZER MATERIALS—San Antonio, Tex.—Amer. Fertilizer & Chemical Wks., Inc., Box 35, Sta. A, want prices on materials used in making complete fertilizers, incl. cotton and burlap bags, nitrogen, phosphoric acid, potash; also purchasing, mixing and weighing machines for plant at San Saba.

EQUIPMENT

PROPOSED WORK

SIGNALS—Boston, Mass.—Supply Dpt., rejected bids Sept. 16, isolated traffic signals as specified to Transit Comn. Will readvertise.

BIDS ASKED

MARINE ENGINE—Somerville, Mass.—J. A. McCarthy, 10 Lake St., in market 6 cylinder marine engine with reverse gear.

HEAT-TREATING FURNACES, etc.—Midland, Mich.—Dow Chemcial Co., in market heat-treating furnaces, straightening mill and fabricating equipment for sheets to 5 ft. in width, for rolling mill to be built here.

PUMP, etc.—Benson, Minn. — Sept. 28, by S. A. Berg, city clk., 500 g.p.m. motor driven turbine pump, accessories.

LABORATORY EQUIPMENT, etc—Cleveland, O.—Oct. 5, by Bd. Educ., F. G. Hogen, dir., furnishing laboratory and library equipment for 3 new high schools.

ENGINE and GENERATOR—Morganza, Pa. Commonwealth of Pennsylvania, W. F. Penn, supt., Pennsylvania Training School, new engine and generator for power plant improvement, J. N. Chester, Engineers, Clark Bldg., Pittsburgh, engrs.

REGULATOR—Appleton, Wis.—Oct. 6, by City, c/o R. Thomas, supt. P. Wks., voltage regulator for entire city current.

CONTRACTS AWARDED

ELECTRICAL EQUIPMENT—Chicago, Ill.—Commonwealth Edison Co., 72 West Adams St., electrical equipment for plant at Crawford Ave. Sta., to Westinghouse Electric & Mfg. Co., 150 Bway., New York. Est. $250,000.

FOREIGN

New Zealand, Dunedin—Oct. 28, by City Clerk, 35,000 volt oil current breakers and metering equipment.

New Zealand, Wellington—Oct. 14, by Secretary Posts & Telegraph Dpt., supplying 192 instrument tools.

New Zealand, Wellington—Nov. 10, by Secretary Stores Div., General Post Office, 3,500 condensers, 2 microfarads, 1,150 condensers 0.5 mic., 1,000 condensers, 1 mic. and 2,300 lampcaps.

New Zealand, Wellington—Nov. 17, by General Manager New Zealand Rys., complete equipment for 3 automatic sub-stations.

New Zealand, Wellington—Nov. 17, by Secretary Stores Div., General Post Office, 950 resistance spools.

New Zealand, Wellington—Dec. 1, by Secretary Dpt. P. Wks., 1 celetrical heating furnace for annealing cast iron Pelton Wheel buckets.

Union Socialist Soviet Republics — Soviet Govt., c/o Amtorg Trading Co., 261 5th Ave., New York, will soon construct car building plant at Nizhni Tagil, in Urals, by technical aid contracts. To exceed $1,000,000.

Commercial Buildings

RESIDENTIAL

BIDS ASKED

Mass., Framingham—Kendall Hotel, and F. H. Hulton, Hemingway Bldg., taking bids altering 4 story, basement, brick hotel. $150,000. C. W. Porter, 306 Concord St., archt.

N. J., Bernardsville — See "Contracts awarded."

N. J., Elizabeth—See "Contracts Awarded."

N. Y., Bayside—See "Contracts Awarded."

N. J., South Orange—Harris & Sohn, archts., 17 Mechanic St., Newark, taking new bids on separate contracts two 2 and 3 story, brick, steel, stucco, Irvington Ave., Kilburn Pl. and Normandy Court, for Morris Mandelbaum, 7 East 42nd St., New York. $300,000. Noted Sept. 10.

N. J., Union City—See "Contracts Awarded."

N. Y., Brooklyn—See "Contracts Awarded."

N. Y., Flushing—See "Contracts Awarded."

N. Y., New York—See "Contracts Awarded."

O., Cleveland — G. R. Gale, 3355 Tullamore Rd., taking bids 4 story, basement, brick, steel, concrete, Shaker Blvd. $250,000. Fox, Duthie & Foose, 1936 Union Trust Bldg., archts.

Ont., Toronto—See "Contracts Awarded."

CONTRACTS AWARDED

N. J., Bernardsville—Thomas Land Co., Lyons, seven 3 story, basement, brick, steel, Lyons Rd., near Somerset Ave., separate contracts. $175,000. Private plans.

N. J., Elizabeth—Verona Constr. Co., A. Meltz, 160 Park Pl., Newark, 3 story, basement, brick, steel, separate contracts. $150,000. Harris & Sohn, 17 Mechanic St., Newark, archts.

N. J., Union City—H. Brustin, 1226 1st Ave., North Bergen, 4 story, basement, brick, steel, 40th St., separate contracts. $150,000. B. Singer, 921 Bergen Ave., Jersey City, archt.

N. Y., Bayside—Kings Builders, Inc., Northern Blvd. and 217th St., apartment, Oakland Hills, separate contracts. $150,000. **Maturity late in winter.**

N. Y., Brooklyn—Carvin Building Co., inc., I. Goldberg, secy., 44 Court St., 6 story, 84 x 140 ft., East 27th St. and Avenue I, separate contracts. $200,000. Cohn Bros., 215 Montague St., archts.

N. Y., Brooklyn—Flatbush Studio Homes, 522 East 51st St., apartment, East 48th St. and Clarendon Rd., by separate contracts. $150,000. F. Ober, 44 Court St., archt.

N. Y., Brooklyn—Hotel Shelbourne Holding Corp., L. Fischer, pres., 521 5th Ave., 6 story, basement apartment hotel, day labor and separate contracts. $1,200,000. M. B. Adler, 292 Madison Ave., New York, archt.

N. Y., Brooklyn—Nathan Street Building Corp., 16 Court St., 71 x 104 ft., Nathan St. and Ocean View Ave., separate contracts. $160,000. B. W. Dorfman, 66 Court St., archt.

N. Y., Flushing—Corporation, c/o F. W. Scutt, 155-03 Jamaica Ave., Jamaica, 115 x 175 ft., Bowne and Roosevelt Sts., separate contracts. To exceed $200,000.

N. Y., New York—Corporation, c/o A. Weinberger, 2855 3rd Ave., 6 story, 63 x 225 ft., Nelson Ave. near Macombs Rd., separate contracts.

Ont., Toronto—E. Fryer, 320 Keewatin Ave., 4 story, basement, brick, steel concrete, Eglinton Ave., some of work by day labor and other by separate contracts. $150,000. Private plans.

CLUBS

PROPOSED WORK

N. J., Englewood—Englewod Women's Club, R. C. Gambee, chn., 162 Booth Ave., bids about March, 2 story, basement, brick, steel, club house, Lydecker St. $150,000. Architects name withheld. Noted June 4.

N. Y., Atlantic Beach—Atlantic Beach Club plans by J. Urban, 5 East 57th St., New York, club, apartment. $150,000.

BIDS ASKED

N. J., Paterson — Goodman & Schulman, archts., 20 Smith St., taking bids 2 story, basement, brick, steel club house, 12th Ave. and Carroll St., for Workmen's Circle Labor Lyceum Corp. $150,000. Noted Sept. 17.

CONTRACTS AWARDED

Mass., Everett—Parlin Associates, F. E. Jennings, in charge, 45 Milk St., Boston, 2 story, basement, brick, stone dormitory addition to Y.M.C.A., plain found., to L. R. Porter Co., 156 Stuart St., Boston. Est. $150,000. Noted Sept. 10.

Va., Richmond—Richmond Baltimore Holding Co., E. Malmberg, secy. and treas., Emerson Hotel, Baltimore, Md., 10 story, concrete, brick, steel clubhouse, to A. J. Saville, Inc., Electric Bldg., and Wise Granite & Constr. Co., 26th and Hull Sts. Est. $800,000.

HOSPITALS

PROPOSED WORK

Me., Togus—National Home for Disabled Volunteer Soldiers, adj. J. L. Boyle, Augusta, soon takes bids 7 story, basement, 45 x 336 ft., brick, stone, rein.-con. hospital. $750,000. Coombs & Harriman, 11 Lisbon St., Lewiston, archts. Noted Oct. 2.

N. J., Newark—J. H. and W. Ely, archts., 15 Washington St., bids in March, 4 and 5 story, basement, brick, steel, rein.-con. hospital, nurses home, power house and out patients building, High and Quirtman Sts., for St. Barnabas Hospital, J. G. Martin, supt. $1,500,000. Noted Jan. 29.

N. J., Plainfield—Columbus General Hospital, 1156 Park Ave., will not build 4 story, basement, brick, steel, Park Ave. $150,000. Project abandoned. Noted July 16.

N. M., Raton—Catholic College and Bishop J. Schrembs, chn., Cleveland, O., plans by Trost & Trost, Two Republics Bldg., El Paso, Tex. (1st unit) sanitarium and priests home. $1,500,000. Total $3,000,000.

Tex., El Paso—City and El Paso Co. plans by Trost & Trost, El Paso, city-county hospital. $250,000.

Ont., Windsor—Essex Border Utilities Comn., Canada Bldg., plans by Pennington & Boyde, Security Bldg., 3 or 4 story, basement, concrete, brick, steel, stone sanitarium. $600,000. J. C. Keith, Canada Bldg., engr.

BIDS ASKED

Mass., Waverly—Commonwealth of Massachusetts, Dpt. Mental Diseases, State House, Boston, taking bids 3 story, brick, steel dormitory. $150,000. J. H. Ritchie & Associates, 250 Stuart St., Boston, archts.

Miss., Jackson—Oct. 30, by State Hospital Removal Improvt. & Land Sale Comn., Capitol Bldg., mechanical work on Receiving Building 3 and on 6 doctors' cottages, N. W. Overstreet, Standard Life Bldg., archt. Noted Aug. 27.

Mo., St. James—Sept. 26, by State Federal Soldiers Home, O. D. Hall, supt., Administration Bldg., brick, concrete hospital.

N. J., Lakeland—Oct. 2, by Lakeland Central and Mental Hospital Coms., Court House, Camden, 6 story, basement, 114 x 243 ft. brick, rein.-con. hospital, for Bd. Freeholders, Camden Co., Camden. Green & McNelly, 300 Bway., Camden, archts. Noted July 23.

N. J., Newark—Bd. City Comrs., City Hall, bids about Oct. 1, 2 story, basement, brick, steel ward and recreation addition, Ivy Hill Almshouse. $200,000. J. T. Simpson, 45 Walnut St., archt. Noted Aug. 12.

N. J., Newark—J. H. and W. C. Ely, archts., 15 Washington St., taking bids general contract altering and constructing 4 story, basement, brick, steel hospital addition, Central Ave., for Newark Eye & Ear Infirmary, 77 Central Ave. $150,000.

Mich., Detroit—Arnold Home for Aged, c/o Weston & Ellington, archts., 1508 Stroh Bldg., 4 story, part basement, brick, stone, steel, concrete building for hospital and home for aged, plain found., Southfield St. and Seven Mile Rd., to Walbridge-Aldinger Co., 1300 Buhl Bldg. Est. $185,000.

CONTRACTS AWARDED

Miss., Jackson—State Hospital Removal Improvement & Landsale Comn., New Capitol Bldg., to Ogden & Glenn, Hattiesburg, receiving building, $107,000, disturbed cottages 1 and 2, $54,255 each, to Dye & Mullings, Columbia, recreation building $24,395, tuberculosis building $34,394; to Grinell Co., Inc., 248 Highland Ave., steam distribution for white group, $112,860; to J. J. Baxter, 664 South State St., steam tunnel work negro group, $32,853; to Peters Heating Co., 121 South President St., heating for Negro Group 3, $19,375, heating for Patients Cottages 1, 2, 3 and 4 $15,000; to S. S. Richard, Jackson, plumbing for Negro Group 3, $17,900; to J. N. Williams, Jackson, electric wiring for Negro Group 3, $5,400; to J. B. Hayden, Pass Christian, plumbing for Patients Cottage 4, $1,750, heating $3,100, plumbing for Patients Cottages 1, 2, 3 and 4 $15,000, heating for Infirmary Buildings 1 and 2 $7,450, heating for Attendants Cottages 1 and 2 $3,650; to Paine Heating Co., 127 South State St., plumbing for Infirmary Buildings 1 and 2, $9,100, for Attendants Cottages 1 and 2 $5,000. Grand total $522,737. Noted Aug. 27.

N. H., Nashua—Memorial Hospital, 8 Prospect St., 3 story, basement hospital, to S. Belanger & Son, Inc., 308 Main St. Est. $150,000.

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Hospitals (Continued)

N. Y., Wingdale—Dpt. Mental Hygiene, State Office Bldg., Albany, general contract Buildings 18, 19, 20, 21, 22, 23, 29, 30, 31, 32, 33 and 34, at Harlem Valley Hospital, to M. Shapiro & Son, 1560 Bway., New York,. This corrects report in Sept. 17 issue.

Ont., Orillia—Dpt. P. Wks., Parliament Bldgs., Toronto, 3 story, basement, concrete, brick, steel, stone, hospital addition to E. Webb & Sons Orillia. $250,000. Noted May 28.

Que., Montreal—Western Hospital, 10 story, L-shaped hospital addition and power house, Tupper St. and Essex Ave., to Anglin-Norcross, Ltd., 2063 Victoria St. Est. $1,000,000.

CHURCHES

PROPOSED WORK

N. J., Jersey City—Westminster Presbyterian Church, H. L. Wyatt, pastor, 304 Academy St., revised plans by W. Neumann, 26 Journal Sq., altering 2 story, basement, brick, steel church, Summit and Magnolia Sts. $150,000 Plans for new church abandoned. Noted Aug. 6.

N. Y., New York—Russian Eastern Orthodox Church, c/o J. R. Oltarsh, atty., 280 Bway, or c/o Holy Cross Orthodox Church, 23 West 124th St., church, school, 1745 Washington Ave. To exceed $150,000.

N. Y., West New Brighton—St. Paul's Roman Catholic Church, church, Clinton Ave. $150,000. **Maturity indefinite.**

Okla., Oklahoma City — Episcopal Congregation, c/o T. Cassady, pastor, 5 story, basement, 200 x 294 ft. cathedral. $4,000,000. **Maturity in summer 1932.** Myers, Murray & Phillip, 2 West 47th St., New York, archts. Noted May 22.

BIDS ASKED

N. J., Morristown—St. Margaret's Roman Catholic Church, c/o Fanning & Shaw, archts., 49 Ward St., Paterson, bids about Oct. 15, general contract 3 story, basement, brick, steel church, parochial school, Columbia St. and Sussex Ave. $150,000. Noted Sept. 10.

N. J., Newark—F. Nagy & Associates, archts., Bethlehem, Pa., taking preliminary bids general contract 2 story, basement, brick, steel church, rectory, Warwick and Lang Sts. for St. George Greek Church. $150,000.

N. J., Red Bank—N. Hulme, archt., 1524 Chestnut St., Phila., Pa., bids about Nov. 1, general contract 2 story, basement, brick steel church Broad St., for First Methodist Church, F. A. DeMaris, pastor. $200,000. H. E. Tralle Pinehurst Ave. and 183d St., New York, consult. archt. Noted Sept. 10.

Pa., Phila.—Sept. 28, by Presbyterian Church, C. R. Savage, Jr., chn. Bd. Trustees, c/o W. P. Barney & R. W. Baunell, archts., 1805 Walnut St., 3 story, basement, 108 x 180 ft., brick, steel, stone church, Sunday school, plain found., Germantown Ave. and Norman Lane.

CONTRACTS AWARDED

N. Y., New York—Church of St. Roch., Wales Ave. near 149th St., general contract church, rectory, to Valentine Constr. Co., 21 East 40th St. Est. $150,000. Noted Sept. 10.

Ont., Hamilton—Catholic Diocese of Hamilton, J. T. McNally, pastor, 354 King St. W., steel for cathedral, King St. W., for Roman Catholic Diocese to Hamilton Bridge Co.. Bay St. Total est. $500,000. Noted Aug. 6, under "Contracts Awarded."

SCHOOLS

PROPOSED WORK

Conn., Greenwich—Town, Bd. Educ., sketches by W. B. Tubby, 475 5th Ave., New York, school, Hamilton and Gregg Aves. $180,000.

Conn., Milford—Town, C. W. Maddocks, supt. schools, school, South Sect. $150,000. Architect not appointed.

Conn., Waterbury—St. Stanislaus Roman Catholic Parish, S. Blazejowski, pastor, 98 East Farm St., 2 story, basement, 65 x 110 ft., brick, steel school. $150,000. Private plans.

Ill., Macomb—State of Illinois, Capitol Bldg., Springfield, plans by State Div. of Architects & Engineers, Capitol Bldg., Springfield, 3 story, basement, limestone training school at Western State Teachers College. $300,000.

Ky., Louisville—City Bd. Educ., 8th and Chestnut Sts., plans by J. M. Colley, c/o owner, Girls' High School, incl., 1,200 seating capacity auditorium, double gymnasium, cafeteria, laboratories, 3rd and Shipp Sts. $900,000.

Mass., Milton (br. Boston) — Town School Dpt., revised sketches by Shepard & Stearns, 2 story, basement, brick school, Eliot St. $280,000. Noted Mar. 12.

Mass., Cambridge — City School Comn., sketches by R. H. Doane, 60 Batterymarch St., Boston, Rindge Technical School, 3 story, basement, Bway. $1,500,000.

Mich., Detroit—University of Detroit, Six Mile Rd., plans by Malcolmson, Higginbotham & Trout, Industrial Bank Bldg., 2 story basement, rein.-con. library, plain found., Six Mile Rd. $200,000.

Mo., Kansas City—Bd. Educ. soon takes bids 3 story, basement, brick, steel school. $150,000. C. A. Smith, 860 Finance Bldg., archt.

N. J., Dunellen—Bd. Educ., Old Market Rd., will not build 2 story, basement high school. $150,000. Project abandoned. Architect not appointed. Noted Aug. 6.

N. J., Elizabeth—Bd. Educ., 417 South Broad St., will not build 2 story, basement, brick, steel, South St. $150,000. Project abandoned. H. B. Brady, Inc., 333 North Broad St., archt. Noted July 9.

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N. J., Fair Lawn—Bd. Educ., Boro Hall, will not build 2 story, basement, brick, steel, rein.-con., Henderson Sect. $150,000. Project abandoned. Architect not appointed. Noted July 16.

N. J., Jersey City—Bd. Educ., Administration Bldg., Harrison Ave., 3 story, basement, brick, steel, Sherman Ave. $150,000. **Maturity in spring, 1932.** Architect not appointed. Noted July 16.

N. J., Leonia—Bd. Educ., High School, will not build 2 story, basement, brick, steel high school addition. $150,000. Project abandoned. Hacker & Hacker, 201 Main St., Fort Lee, archts. Noted Aug. 6.

N. J., Lodi—Bd. Educ., A. Cody, pres., Wilson School, will not build 2 story, basement, brick, steel, rein.-con. school. $150,000. Project abandoned. Architect not appointed. Noted Apr. 30.

N. J., Newton—Junior High School, Bd. Educ., 2 story, basement, brick, steel, $200,000. Hacker & Hacker, 201 Main St., Fort Lee, archts. **Maturity December, 1931.** Noted Sept. 3.

N. J., Waldwick—Bd. Educ., 3 story, basement, rein.-con., brick, steel school. $150,000. **Maturity probably soon.**

N. J., Plainfield—Bd. Educ., 119 Winan St., will not build 2 story, basement, brick, steel addition to McKinley School. $150,000. Project abandoned. Noted June 18.

N. Y., Brooklyn—Bd. Educ., 500 Park Ave., New York, soon takes bids P. S. 212, 3 story, 90 x 183 ft. Flatlands Ave. and East 100th St. $410,000. W. C. Martin, Flatbush Ave. extension and Concord St., archt. Noted Aug. 20.

O., Cincinnati—Bd. Educ., 511 West Court St., plans by Kruckemeyer & Strong, St. Paul Bldg., 3 story, basement, brick, rein.-con., plain found., Mears and Beacon Sts. $175,000.

Pa., Houston—Bd. Educ., Chartiers Twp., G. Arthur, secy., R.R. 1, Washington, sketches Junior and Senior High School, brick, steel, $150,000. **Maturity next year.** Architect not appointed.

Pa., Pittsburgh—St. Marys of the Mount Roman Catholic Congregation, T. O'Regan, in charge, 403 Grandview Ave., brick, steel school, Bingham and Grandview Aves. $150,000. Architect not appointed.

Tex., Dallas—Bd. Educ. plans, by M. Lemmon, Constr. Industrial Bldg., and takes bids about Dec. 5, 1st unit Junior High School, Trinity Heights Annex on 11.4 acre tract between Maryland St. and Oregon Ave. $250,000; plans by Bryan & Sharp, Contr. Industrial Bldg., 1st unit of Junior High School, east of Trinity River. $200,000.

Tex., San Antonio—Bd. Educ., Lavaca St., plans by R. H. Cameron, Majestic Bldg., G. Willis, Builders' Exch. Bldg., and H. Green, Alamo Natl. Bank Bldg., Senior High School, incl. auditorium, gymnasium, library, manual training unit, Astor and South Pine Sts. $800,000. L. D. Royer, Smith-Young Tower, engr.

Tex., San Antonio—Bd. Educ., Lavaca St., plans by Phelps & DeWees, Bd., archts., Gunter Bldg., A. B. and R. M. Ayres, Smith-Young Tower Bldg., and R. Kelly, Milam Bldg., Junior High School, 2 story, brick, rein.-con., incl. auditorium, library, manual training shops, health unit, class rooms, plain found., Lake Blvd., Huisache and Mulberry Sts. $200,000. L. D. Royer, Smith-Young Tower Bldg., engr.

Ont., Hamilton—Plans by B. H. Prack, 1311 Piggott Bldg., new commercial school, Sanforth Ave. $500,000.

Ont., Toronto—Bd. Educ., 155 College St., plans by C. Dyson, 155 College St., 3 story, basement, stone trimmed, brick addition to Oakwood Collegiate Institute, concrete found. $150,000.

BIDS ASKED

Mass., Brookline (br. Boston)—Sept. 29, by A. Peterson, chn. Building Com., William H. Lincoln School, brick, steel, Boylston St. $400,000. M. P. Meade, 80 Boylston St., Boston, archt. Noted July 31, 1930.

Mass., East Boston (sta. Boston)—City, Dpt. School Buildings, bids about Oct. 1, 2 story, basement, brick, stone school, plain found. $200,000. Noted July 23.

N. J., Bayonne—C. H. Ziegler, archt., 26 Journal Sq., Jersey City, revising plans and takes bids about Nov. 1, general contract 2 story, basement, brick, steel chapel garage, Hudson Blvd., Hudson Co. Parental School, 1241 Hudson Blvd. for $150,000. Noted Aug. 27.

N. J., East Orange—Bd. Educ., 19 Winans St., bids about Nov. 15, Junior High School, 2 story, basement, brick, steel, North Clinton St. and Renshaw Ave. $350,000. Guilbert & Betelle, 20 Branford Pl., Newark, archts. Noted Sept. 10.

N. J., Englewood—L. C. Licht, archt., 4 Dean St., bids about Dec. 1, general contract 2 story, basement, brick, steel school, plain found., for Englewood School for Boys, 35 Dwight Pl. $200,000. Noted Sept. 10.

N. J., Franklin Park—Sept. 25, by Bd. Educ., Franklin Twp. 2 story, basement, 75 x 100 ft., brick, steel, rein.-con. addition to Franklin Park School. $150,000. H. G. Bach, 63 Schureman St., New Brunswick, archt. Noted Sept. 10.

N. J., Franklin Park—Bd. Educ. Franklin Twp., bids about Oct. 1, 2 story, basement, brick, steel school addition. $150,000. H. G. Bach, 63 Schureman St., New Brunswick, archt. Noted Sept. 10.

N. J., Middlebush — Sept. 28, by Bd. Educ. Franklin Twp., taking bids 2 story, basement, brick, steel, West Side. $150,000. J. N. Pierson & Son, 198 Jefferson St., Perth Amboy, archts. Noted Sept. 3.

N. J., Morristown—Bd. Educ., O. M. Gobble dist. clk., 50 Early St., bids about Oct. 15, 2 story, basement, brick, steel, rein.-con., Mill St. $200,000. C. C. Voorhees, 1 Schuyler Pl., archt. Noted Sept. 10.

N. J., Sussex—Sept. 29, by Bd. Educ., J. W. Wilson, clk., general contract 2 story, basement, brick, steel high school, Loomis and Newton Aves. $150,000. Jacoby & Everett, Commonwealth Bldg., Allentown, Pa., archts. Noted Sept. 10.

N. Y., Fairmount—Oct. 14, by Commissioner Dpt. Mental Hygiene, State Office Bldg., Albany, assembly hall, Syracuse State School; adv E.N.R., Sept. 24.

N. Y., Syracuse—Sept. 29, by Bd. Contr. & Supply, City Hall, Junior High School, 3 story, basement, 240 x 240 ft., Grand Blvd. $750,000. W. W. Cronin, State Tower Bldg., engr.

Tenn., Cookeville—Oct. 1, by Putnam Co. Bd. Educ., at office L. S. Dunavin, supt. schools, Central High School. Marr & Holman, 701-703 Stahlman Bldg., Nashville, archts.

Tex., Galveston—Oct. 9, by Bd. Trustees, John Neathy, pres., 2 story, 500 ft. long, irregular sized, rein.-con., hollow tile, brick high school. $350,000. Giesecke & Harris, Norwood Bldg., Austin, and R. R. Rapp, Guaranty Bldg., Galveston, archts. Noted Sept. 3.

Wis., Green Bay—Oct. 2, by Bd. Educ., W. W. Kelly, pres., general contract, 2 story, 60 x 150 ft., brick, steel, rein.-con. school. Foeller & Schober, Green Bay, archts. Noted Sept. 3.

Wis., Milwaukee—Kirchoff & Rose, archts., 196 Water St., taking bids 4 story, basement, 145 x 260 ft., brick, rein.-con. medical school, North 15th St., for Marquette University. Noted July 23.

Man., Winnipeg—Sept. 28, by W. Club, Parliament Bldg., 4 story, 100 x 200 ft., brick science building at university. $600,000. A. Stoughton, Donalda Bl., archt.

CONTRACTS AWARDED

Del., Millville—State School Building, H. V. Holloway, supt., Dover, general contract 2 story, basement, 100 x 158 ft., brick, steel rein.-con. addition to Lord Baltimore School, plain found., to J. A. Bader & Co., Lackey Bldg., Wilmington, $107,393 plumbing and heating to Lewis Morgan & Sons, Salisbury, Md., $22,311; electrical work, to L. G. Gunly Co., Salisbury, Md., $4,702. Grand total $134,406. Noted Sept. 3.

Ga., Atlanta—University of Georgia, Athens, c/o Building Com., H. C. Irwin, chn., 2 story dormitory and 1 story law building, both rein.-con., brick, to Potter & Shakleford, Greenville, S. C. $204,000..

Ill., Decatur—Bd. Educ., C. N. Weilepp, pres., Junior High School, Oakland St., to A. F. Krail, 1977 Wood St., $122,260; addition to Junior High School, to Baker-Patterson Co., 145 Merchant St., $38,544. Noted Apr. 9.

Ky., Louisville—S. D. Jones, bus. dir. Bd. Educ., 7th and Chestnut Sts., general contract, part 2 and 3 story, basement, 170 x 330 ft. greatest dimension, rectangular shape, 2 wings, rein.-con., brick, steel, to J. F. Russell & Co., 3rd and Oak Sts., $171,688; plumbing, to H. Netherton & Co., 114 North 5th St., $10,968; electrical work, to E. G. Knauer, 2226 Eastview St., $6,810. Grand total $189,466. Noted Aug. 20.

Mass., Quincy—City, P. Building Dpt., 2 story, basement, 140 x 175 ft., brick school addition, to M. S. Kelliher Co., 10 High St., Boston. Est. $150,000. Noted Aug. 27.

Mass., West Roxbury (sta. Boston)—City of Boston, Dpt. School Buildings, 2 story basement, brick, stone school, plain found., Robert Gould Shaw Dist., Temple and Perham Sts., to M. Cummings Co., 43 Tremont St., Boston, $134,460. Noted July 9.

Mich., Davison—Bd. Educ., 2 story, basement, 94 x 180 ft. and 52 x 85 ft., brick, steel, concrete, stone high school, incl. library, gymnasium, auditorium, classrooms with offices, plain found., to Sorenson & Gross, Flint. Est. $150,000.

Minn., Marshall—Bd. Educ., H. S. Simons, clk., 2 story, basement, rein.-con., brick, stone, to A. G. Wahl, St. Cloud, $104,984. Noted Aug. 27.

N. J., Montville—Bd. Educ., general contract 2 story, basement, brick, steel to Claus Ahrens & Co., Inc., 72 Uhlandt St., East Rutherford, plumbing, to Ruhl & Hatfield, Inc., 384 South 10th St., Newark; heating, to E. J. Wohrle, Tube Concourse Bldg., Jersey City; electrical work, to C. P. Hansen, 230 New St., Belleville steel and iron, to Passaic Steel Co., 86 Lexington Ave., Passaic. Est. $150,000. Noted Aug. 20.

N. Y., Brooklyn—Bd. Educ., 500 Park Ave., New York, general contract P. S. 236, to Agostini Bros., Goulden and Strong Aves., New York, $289,740. Noted July 23.

N. Y., Brooklyn—Bd. Educ., 500 Park Ave., New York, general contract P. S. 248, to Major Contg. Co., 263 West 38th St., New York, $367,012. Noted July 23.

N. Y., Jamaica—Bd. Educ., 500 Park Ave., New York, general contract P. S. 117, to Gerace & Castagna, Inc., 1721 Emmons Ave., Brooklyn, $251,500. Noted June 11.

N. Y., South Jamaica—Bd. Educ., 500 Park Ave., New York, completing addition for P. S. 123, to E. S. Good Contg. Corp., 162-27 Depot Rd., Flushing. $61,400. Noted Aug. 6.

N. Y., Utica—St. Francis de Sales Church, D. Doody, pastor, 4 story, 108 x 213 ft., Indiana limestone, tan brick, high school, to Bedford Constr. Co., 1300 Broad St., Utica, $234,700. Noted July 2.

Schools (Continued)

Pa., Phila.—Bd. Educ., E. Merchant, secy., general contract Junior High School, 3 story, basement, 183 x 291 ft., rein.-con., brick, plain found., to J. M. Shane, 1610 North St., $767,240; elevator, to Atlantic Elevator Co., D and Erie Sts., $5,285; ventilating, to A. W. Wagman, 2813 West Fletcher St., $12,516; electrical work, to Walker & Kepler, 531 Chestnut St., $63,493; heating, to H. J. Levinson, 1621 Sansom St., $99,783; plumbing, to F. Wackenhut, 2416 Frankford Ave., $60,935. Grand total $1,009,252. Noted Aug. 27.

Ont., Guelph—Ontario Agricultural College, 3 story, basement, stone, concrete, brick addition to main and students buildings to Jackson-Lewis Constr. Co., Federal Bldg., Toronto. Est. $150,000. Noted Apr. 16.

Ont., Toronto—Bishop Strachan School, Lonsdale Ave., general contract altering and constructing 2 story, basement, stone, concrete, steel addition, to J. Witchall & Son, 156 St. Helens Ave. $150,000. Noted Apr. 30.

THEATRES

PROPOSED WORK

N. J., Westfield—Realty Investment Co., R. L. DeCamp, secy., 566 Colonial Ave., will not rebuild Rialto Theatre, 2 story, basement, brick, steel. $150,000. Project in abeyance. Architect not appointed. Noted July 16.

N. Y., New York—Alurion Realty Corp., W. T. Knight, pres., 60 Wall St., bids early in November, general contract altering theatre, 254 West 42nd St. $500,000. T. W. Lamb, 701 7th Ave., archt. Noted Aug. 20.

N. Y., New York—Melrose Bond & Mortgage Corp., P. Murphy, pres., 560 Melrose Ave., 2 story, basement, brick theatre, Grand Concourse and Mount Eden Ave. $175,000. Project in abeyance. E. DeRosa, 18 East 41st St., New York, archt. Noted Aug. 19.

BANKS

PROPOSED WORK

N. Y., Brooklyn—First Mortgage Securities Corp., 2650 Atlantic Ave., plans by Halsey, McCormick & Helmer, 286 5th Ave., New York, 1 story bank, Pitkin and Hopkinson Aves. $150,000.

N. Y., Brooklyn—Lincoln Savings Bank, 531 Bway., plans by Koch & Wagner, 32 Court St., 2 story, 42 x 100 ft. bank, Church and Nostrand Aves. $175,000.

O., Toledo—Toledo Trust Co., 245 Summit St., plans by Walker & Weeks, 2341 Carnegie Ave., Cleveland, 5 story bank and office interior alterations. $200,000.

OFFICES

PROPOSED WORK

Ont., Toronto—Toronto Hydro-Electric System, 225 Yonge St., 15 story, concrete, brick, stone, steel office. $1,000,000. Excavation by day labor, now under way, balance to be let by contract. Private plans. Harkness & Hertzberg, Confederation Life Bldg., structural engrs. H. H. Angus, 25 Bloor St. W., heating engrs. McMaster-Jacob Eng. Co., 900 Bay St., electrical engrs. Noted Sept. 11.

BIDS ASKED

N. J., East Orange—Warren & Warren, archts., 31 Clinton St., Newark, bids about Oct. 15, general contract 2 story, basement, brick, steel office store, Central Ave. for Owner c/o architects. $150,000. Noted Sept. 3.

N. J., Jersey City—D. J. Scrocco, archt., 60 Park Pl., Newark, bids about Oct. 17, general contract 13 story, basement, 100 x 150 ft., brick, steel, rein.-con. office, store, Summit Ave., for Owner, c/o architect. $650,000. Noted Sept. 10.

CONTRACTS AWARDED

Ont., Toronto—See "Proposed Work."

N. Y., Cortland—H. B. Turner & F. A. Rogalsky, 7 story, 45 x 66 ft. office building with 2 stores and arcade on 1st floor, 8-10 Groton Ave., to J. Dall Constr. Co., Ithaca. Est. $250,000.

STORES

PROPOSED WORK

N. J., Hackensack—Sears, Roebuck Co., Port Newark, sketches and may take bids in November, 4 story, basement, brick, steel department store, Main, Anderson and River Sts. $150,000.

N. J., Newark—Owner, c/o N. Siegler, archt., 164 Market St., sketches 2 story, basement, brick, steel, stone store, office, 55 Market St. $150,000.

BIDS ASKED

N. J., Newark—Owner, c/o Harris & Sohn, archts., 17 Mechanic St., bids about Oct. 15, general contract 2 story, basement, brick, steel, store, apartment. $150,000. Noted Sept. 24.

N. J., North Bergen—North Bergen Auto & Electric Supply Co., 883 Bergenline Ave., and F. Hubert, archt., 116 Hauxhurst Ave., Weehawken, bids about Oct. 1, general contract 2 story, basement, brick, steel store, dance hall, 879-81 Bergenline Ave. $150,000. Noted Sept. 10.

CONTRACTS AWARDED

N. J., East Orange—I. Bachman, c/o Siegler & Greenberg, archts., 164 Market St., Newark, general contract 2 story, basement, brick, steel, store, office, apartment, Dodd and Prospect Sts., to I. Rekoon, 60 Park Pl., Newark. Est. $150,000. Noted Sept. 17.

PUBLIC

PROPOSED WORK

Mass., Belmont — DORMITORY — Commonwealth of Massachusetts, Dpt. Mental Diseases, State House, Boston, plans by J. H. Ritchie & Associates, 250 Stuart St., Boston, and soon takes bids 3 story basement, brick, stone, employees dormitory, plain found. at W. E. Fernald State School. $150,000.

N. J., Elizabeth—HOME—Bd. Freeholders Union Co., Court House, brick, steel welfare home. $300,000. **Maturity probably soon.** Architect not appointed.

N. J., Millburn—LIBRARY—Bd. Trustees, D. K. Irwin, chn., Township Hall, will not build 2 story, basement, brick, steel library. $150,000. Project abandoned, no funds available. Architect not appointed. Noted June 25.

N. J., New Brunswick—COURT HOUSE—Bd. Freeholders Middlesex Co., County Record Bldg., sketches by Boylan & Levine, 143 Albany St., rebuilding 3 story, basement, brick, steel. $150,000.

N. J., Paterson—JAIL and HALL of RECORDS—Bd. Freeholders Passaic Co., Court House, bids about March general contract 8 story, basement, brick, steel, rein.-con., detention jail and hall of records, Grand St. between Spring and Jackson Sts. $3,500,000. H. B. Crosby, 1st Natl. Bank Bldg., archt. Noted March 19.

N. J., South Belmar—BORO HALL etc.—Bd. Boro Council, Boro Hall, sketches by H. B. Seymour, 512 McClellan Ave., Long Branch, 2 story, basement, brick, steel boro hall, police headquarters, jail. $150,000. Noted Apr. 23.

Pa., Brookville—HOME—Pennsylvania Memorial Home, J. H. Henderson Post, American Legion, Oil City, sketches by Brenot & Brown, Traymore Bldg., Oil City, 3 story, basement, brick, hollow tile, $150,000. **Maturity next spring.**

Ont., Hamilton—CITY HALL—City—Concrete steel, stone, brick addition. $300,000. Architect not appointed.

BIDS ASKED

N. J., Bernardsville—LIBRARY—Bd. Trustees bids probably in November 1 story, basement, brick, steel. $150,000. Noted Sept. 10.

N. J., Bradley Beach—MUNICIPAL—Bd. City Council, 701 Main St., bids about Oct. 15, altering and constructing 2 story, basement, brick, steel addition, Main St. and LaReine Ave. $150,000. K. M. Towner, Kinmouth Bldg., Asbury Park, archt. Noted June 11.

N. Y., New Rochelle—ARMORY—Oct. 14, by Adjutant-General, Div. Military & Naval Affairs, Capitol, Albany, naval militia armory; adv. E.N.-R., Sept. 24.

N. Y., Peekskill—ARMORY—Oct. 14, by Adjutant-General Div. Military & Naval Affairs, Albany, general contract state armory; adv. E.N.-R., Sept. 24.

CONTRACTS AWARDED

Ark., Monticello—COURT HOUSE—Drew Co., c/o W. E. Spencer, judge, and Building Com., general contract 3 story, brick, concrete, to Hewitt & Russell, Little Rock, $98,050; heating and plumbing, to Pfeifer Plumbing Co., 717 Main St., Little Rock, $9,812; electric wiring, to Arkansas Electric Co., 4th and Louisiana Sts., Little Rock, $3,300. Grand total $111,162. Noted Aug. 13.

Conn., Newtown—LIBRARY—Town, H. C. Hubbell, 2 story, basement, 35 x 70 ft. and 32 x 65 ft. brick, stone, to Hewlitt Co., 886 Main St., Bridgeport. $20,000. Noted Sept. 3.

N. J., Hackensack—ADMINISTRATION—Bd. Freeholders Bergen Co., Court House, general contract administration building to F. W. Bogert, 134 Prospect Ave., Hackensack, $732,598. Noted Sept. 3.

R. I., Newport—FIRE STATION—City, W. N. Sayer, clk., 2½ story, basement, brick, stone, to O. D. Purington & Co., 49 Westminster St., Providence. Est. $150,000. Noted Aug. 27.

Wis., Milwaukee—HEALTH CENTER—Dpt. P. Wks., excavation, concrete masonry, terrazzo, tile for Matthew Keenan Health Center, 3 story; basement, 90 x 110 ft., to E. Grether, 4506 West Roosevelt Dr., $57,364; carpentry, hardware, metal doors, roofing, to E. F. Wierdsman & Son, 4140 West Lisbon Ave., $15,339—cut stone, granite, to Milwaukee Cut Stone Co., 2140 West Cornell St., $3,816; structural steel, ornamental iron, to C. Hennecke Co., 3225 North Pierce St., $13,308; painting, glazing, to P. Lesch, 2720 South Kinnickinnic Ave., $3,170; sheet metal, copper, to Atlas Sheet Metal Wks., 2348 North Teutonia Ave., $1,099; plumbing, drainage refrigeration, to Downey Heating Co., 1739 West St. Paul Ave., $9,996; heating, ventilating, to Pflugrodt Heating Co., 2405 West Grand St., $15,863; plastering, lathing, to Walish-Dufton Co., 1729 West Water St., $10,277; electrical work, to A. Kieckhefer Elevator Co., 1100 West St. Paul Ave., $4,990. Grand total $135,222. Noted July 13.

UNCLASSIFIED

PROPOSED WORK

Ill., Belleville—MAUSOLEUM—Valhalla Burial Park Assn., W. Schrader, secy. and treas., 8 South High St., sketches by T. P. Barnett Co., 1569 Arcade Bldg., St. Louis, Mo., rein.-con., stone mausoleum, Hy. 13, 3 mi. west of here. $400,000.

N. Y., New York—HOME for AGED—Catholic Charities of Archdiocese of New York, 477 Madison Ave., sketches institutional buildings, also small alterations on existing buildings, Van Courtland Park, Saxon and Dickson Aves. Est. exceeds $150,000.

O., Dayton—RAILROAD DEPOT—City, Cleveland, Cincinnati, Chicago & St. Louis R.R., H. Baldwin, ch. engr., Erie R.R., G. S. Fanning, ch. engr., Cleveland, O., Baltimore & Ohio R.R., S. A. Jordan, engr. maintenance and ways western lines, Cincinnati, O., Pennsylvania R.R., I. W. Geer, ch. engr. western region, Chicago, Ill., remodeling union station in connection with track elevation, incl. new plaza, platforms, street approaches, waiting rooms, etc., $3,500,000.

BIDS ASKED

Mass., Worcester—HOME—Sept. 25, by Jewish Home for Aged & Orphans, 25 Coral Ave. and Fuller & Delano, archts., 44 Front St., 3 story, basement, 90 x 130 ft. brick, tile, home, plain found., Kendall St. To exceed $150,000. Noted Aug. 6.

CONTRACTS AWARDED

Ind., Indianapolis — LABORATORY, etc. — Eli Lilly Co., Alabama and McCarty Sts., general contract 4 story, basement, 50 x 222 ft. pharmaceutical and medical laboratory building, and 50 x 84 ft. auxiliary building in rear, brick, rein.-con., Alabama and McCarty Sts., to L. Colvin, Continental Bank Bldg. Est. $500,000.

Mich., Detroit—MERCANTILE—Sears Roebuck & Co., Grand River Ave., 2 story, brick, rein.-con. addition, plain found., to Patterson Eng. Co., 2631 Woodward Ave. Est. $300,000.

Industrial Buildings

FACTORIES AND MILLS

PROPOSED WORK

Calif., Tulare—ICE PLANT—Central California Ice Co., 702 P St., Fresno, soon lets contract 60 x 100 ft. ice manufacturing plant, office, South K and Sonora Sts. $45,000.

Ill., Calumet City — CHEMICAL PLANT — D. & G. Chemical Co., F. L. Lofgren pres., rebuilding plant, damaged by fire. To exceed $100,000. **Maturity indefinite.**

Ill., Decatur—DAIRY—Decatur Milk Assn., A. McIntosh, secy., sketches 1 story plant, incl. equipment, Main St. $40,000. Private plans.

Ind., Gary—PLANT — Gary Warehouse Co., plans by J. Wonson, 1325 Marshall St., 1 story, 60 x 90 ft. brick, steel, 10th St. and Massachusetts Aves. $40,000.

Md., Baltimore—PLANT—Atlantic Refining Co., Keyser Bldg., rebuilding plant, Key Hy. and Lawrence St., recently damaged by fire, incl. 11 storage tanks to be relocated and 2 more to be constructed.

Mich., Midland — ROLLING MILL — Dow Chemical Co., 1 story, brick, steel, rein.-con. rolling mill for magnesium alloy sheets. $50,000. Private plans.

Mass., Fall River—STATION, etc.—Firestone Realty Co., c/o Firestone Tire & Rubber Co., taking bids 1 story, concrete station, office. $40,000. Private plans.

N. J., Jersey City—ICE PLANT—C. Ziegler, archt., 26 Journal Sq., 1 story, basement, brick, steel ice plant, for owner, c/o architects. $40,000. Noted Sept. 10.

N. J., Lyndhurst—PRINTING PLANT, etc.—Commercial Leader Co., Inc., 356 Valley Brook Ave., 2 story, basement, brick, steel, printing plant and office, Valley Brook Ave. $40,000. **Maturity probably soon.** Architect not appointed.

N. J., Wallington — BAKERY PLANT — J. Boruta, 103 Halstead St., 2 story, basement, 75 x 75 ft. brick, steel bakery plant, stores, garage, Wallington Ave. and Mercer St. $40,000. Bids in. Project in abeyance. J. T. Camlet, 26 Piaget Ave., Clifton, archt. Noted Sept. 3.

N. Y., Brooklyn—FACTORY—Reid Ice Cream Co., revised plans by J. E. Ross, 25 West 43d St., New York, altering 4 story factory, and tanks, Waverly and Atlantic Aves. $110,000.

N. Y., Jamestown—BOTTLING PLANT—Coca Cola Bottling Corp. of Jamestown, Inc., Jamestown, or c/o Coco Cola Co., 560 Edgewood Ave. N.E., Atlanta, Ga., bottling plant. $45,000.

N. Y., Rochester—FILM PLANT—Eastman Kodak Co., 343 State St., rebuilding film manufacturing plant. To exceed $40,000.

Okla., McAlester—ICE PLANT—Community Ice Co., Sulphur Springs, Tex., sketches ice plant. $50,000. E. L. Ascheraft, Sulphur Springs, Tex., engr.

Okla., Sapulpa—ICE PLANT—Community Ice Co., Sulphur Springs, Tex., sketches 25 ton ice plant. $50,000. E. L. Ascheraft, Sulphur Springs, Tex., engr.

Pa., Phila.—PLANT—Coff Dye Wks., 269 East Ashmad St., sketches rebuilding plant, recently destroyed by fire. To exceed $40,000.

Pa., Washington—PACKING PLANT—Albert Packing Co., Cecil, G. Albert, in charge, sketches brick, steel, new machinery. $40,000. Architect not appointed.

S. C., Lyman—TEXTILE MILL—Lyman Mills, Inc., c/o Lockwood Greene, engrs., 100 East 42nd St., New York, soon takes bids addition. $500,000.

Ont., Toronto—BAKERY—Barkers Bread Ltd., 230 Walmer Rd., plans by Chapman & Oxley, Sterling Tower, 3 story, basement, concete, brick, steel addition. $75,000.

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Factories and Mills (Continued)

BIDS ASKED

Ill., Chicago—BUTTER PLANT, etc.—See "Contracts Awarded."

Ky., Louisville—TRANSFORMING SUB-STATION—See "Contracts Awarded."

Mass., Whitman—FACTORY—United Shank & Findings Co., c/o United Shoe Mchy. Corp., 140 Federal St., Boston, taking bids altering and constructing 2 story, brick, timber mchy. addition. $40,000 or more. C. W. Hall, c/o owners, archts.

N. J ,Hoboken—FACTORY—Garsten Realties Co., J. Bonanno, pres., 1827 Bergen Turnpike, North Bergen, bids about Nov. 1, general contract, 1 story, basement, brick, steel, Madison and Jefferson Sts., between 14th and 15th Sts. $40,000. Private plans. Noted June 25.

N. J., Newark—FACTORY—See "Contracts Awarded."

N. Y., Port Richmond—LAUNDRY—M. G. Uslau, archt., 57 Bay St., St. George, bids about Oct. 15, general contract altering and constructing 1 story, basement, 50 x 65 ft. and 1 story, basement, 25 x 75 ft. brick, steel additions. Jewett Ave., for Pal-Birn Steam Laundry Co., J. Palladino, pres., 89 Jewett Ave. $40,000. Noted Sept. 3.

Pa., Allenport—TUBE MILL—See "Contracts Awarded."

R. I., Bristol—PLANT—Herreshoff Mfg. Co., c/o E. M. Corbett, archt., 49 Purchase St., Fall River, Mass., taking bids 2 story, brick, steel, plain found., Hope St. $40,000.

CONTRACTS AWARDED

Calif., Vernon—FERTILIZER PLANTS—Stauffer Chemical Co., 624 California St., San Francisco, awarded contract for design and construction 88 x 140 ft. and 36 x 60 ft. additions, to Austin Co., 16112 Euclid Ave., Cleveland, O. Est. $50,000.

Ill., Chicago—BUTTER PLANT, etc.—Central Mfg. Dist., 38 South Dearborn St., butter plant refrigeration warehouse, separate contracts. To exceed $40,000. Great Atlantic & Pacific Tea Co., 420 Lexington Ave., New York, lessee will transfer manufacturing equipment from its present plant to new building.

Ind., Indianapolis — PACKING PLANT — Hilgemeier Bros., 519 West Raymond St., general contract 3 story, basement, 22 x 91 ft., brick, steel, 519 West Raymond St., to W. P. Jungelaus & Co., 825 Massachusetts Ave. Est. $40,000.

Ind., Stinesville — PLANT — Swenson Stone Co., Bloomington, 1 story, 55 x 180 ft., brick, steel, stone, to Bedford Fdry. & Machine Co., Bedford. Est. $43,000.

Ky., Louisville—TRANSFORMING SUBSTATION—Louisville Gas & Electric Co., 311 West Chestnut St., tall 1 story, concrete steel, 1710 South 11th St., own forces. $250,000.

Mass., Somerville—DAIRY PLANT—National Dairy Products Co., Franklin Div., 66 Washington St., general contract 3 story, basement, 62 x 125 ft. rein.-con. Washington St., to John W. Duff, Inc., 146 Summer St., Boston. Est. $200,000. Owner taking bids excavation for above.

Mass., South Dartmouth—SAUSAGE FACTORY—Correia & Sons, 18 Puritan St., 2 story, brick, timber, to N. St. Pierre, 10 King St., New Bedford. Est. $40,000. Noted Sept. 17.

Mass., Worcester—FACTORY—Vellumoid Co., 54 Rochdale St., 1 story, 30 x 65 ft., brick, steel addition, to A. J. Daniels, Shrewsbury.

N. J., Newark—FACTORY—C. T. Miller, 1000 Sterling Rd., Union, 2 story, 40 x 100 ft., brick, steel factory, stores, 105 Thomas St. separate contracts. $40,000. Private plans.

N. J., Newark—FUR DYEING PLANT—P. A. Singer & Bros., 169 Malvern St., general contract 2 story, basement, brick, steel, hollow tile, addition 171 Malvern St., to J. A. Thorworth, 249 Pomona Ave. Est. $40,000.

N. Y., Buffalo—INDUSTRIAL—Meyer-Smith, Inc., 408 Bway., 3 story, basement, 90 x 200 ft., building for storage and display rooms, to C. Berrick Sons & Co., 1151 Main St. $100,000.

Pa., Allenport — TUBE MILL — Pittsburgh Steel Co., Union Trust Bldg., H. D. Williams, pres., will build mill, own forces, under supervision J. D. Chase, supt. Monessen Plant. $1,000,000. V. Chartner, Monessen, engr.

Pa. Freedom—MILL—Freedom Oil Co., E. J. Bischoffberger, general mgr., 3 story, basement, 78 x 241 ft., brick, concrete, steel, to R. B. McDanel, 4th Ave. and 7th St., New Brighton. Noted Aug. 20.

Pa., Landsdale—HOSIERY MILL—Interstate Hosiery Co., 3 story, basement, 52 x 260 ft., rein.-con., brick, plan found., to W. F. Lotz, Oxford St., and Limekiln Pike, Phila. Est. $120,000.

Pa., Pittsburgh—DAIRY, CREAMERY, etc. —Leopold Vilsack Estate, 424 North Highland Ave., 2 story, basement, 50 x 100 ft. dairy and creamery 1 story, 35 x 100 ft. garage, concrete, brick, steel, 6465 Hamilton Ave., to J. A. Romano, 1453 Barnesdale St. Est. $60,000.

Tex., Amarillo—ICE PLANT—H. C. Badger & A. Davidson, c/o Herring Hotel, 1 story, 45 x 70 ft., brick, rein.-con. ice plant. $50,000. Owner builds. H. M. Warren, 1012 Pierce St., archt.

Tex., San Juan—PACKING PLANT—Valley Box & Crate Factory, c/o R. T. Agar, San Benito, 1 story, 53 x 88 ft., brick, rein.-con., plain found., to O. T. Wallace, San Juan. South Texas Produce Co., lessee.

Tex., Santa Rosa—ICE PLANT—R. E. Ewing, Santa Rosa, 1 story, steel, stucco, rein.-con. found., to C. C. Daniels, Santa Rosa. Est. $80,000. This corrects report in Sept. 17 issue under "Edcouch, Tex."

Wis., Bangor—PLANT—Village, E. A. Merls, clk., general contract 2 story, 60 x 90 ft., brick, tile pumping plant, to Naslt Bros. Co., Sparta. Est. $40,000.

Wis., Beaver Dam—FACTORY—Kraft Phenix Cheese Corp., W. Baird, supt., 3 story, basement, brick, steel, rein.-con., to Huttle Constr. Co., 128 Western Ave., Fond du Lac. Est. $40,000.

Ont., St. Thomas — FACTORY — Canadian Vitrified Products Co., J. E. Rodgers, Mgr., 1 story, 200 x 300 ft., brick factory and equipment, incl. 6 oil fired kilns, to Austin Co. Canada Permanent Bldg., Toronto. Est. $125,000.

GARAGES

PROPOSED WORK

Mass., Pittsfield—Pittsfield Electric Co., C. E. Merrill, Pearl St., bids in October, 3 story basement, brick concrete service office, garage, Pearl St. and Renne Ave. $75,000. Private plans. Noted July 23.

N. Y., Brooklyn—Two Hundred and Forty-Five West Twenty-Sixth St. Inc., c/o Samuel Silk, 50 Clark St., 4 story D'humy ramp garage, 450 car capacity, 22,000 sq.ft. floor space, Brighton Beach Ave. and Parkway Court. $250,000.

BIDS ASKED

Me., Bangor—See "Contracts Awarded."

Mass., Franklin.—R. Vozella, City Mills, taking bids (extended), 1 story, 90 x 100 ft., brick, steel auto service and showroom, plain found. 42 Central St. $40,000. Private plans. Noted Aug. 20.

CONTRACTS AWARDED

Ind., Ft. Wayne—Standard Oil Co., Leesburg Rd., general contract brick, steel super-service station, Barr and Washington Sts., to E. W. Baumgartner, 1008 High St. Est. $40,000.

Me., Bangor—C. Murray, 18 West Bway, 1 story, brick, rein.-con., steel, garage, service station, plain found., Franklin St., separate contracts. $50,000. V. Hodgins, 39 Hammond St., archt.

N. Y., Brooklyn—A. Panosa, c/o A. H. Schwartz, 90 John St., New York, bids late in winter, general service garage and separate contracts, 100 x 120 ft. $40,000. O. Goldschlag, 55 West 42nd St., New York, archt. Noted Sept. 3.

N. Y., New York—Langner—Salmon, Inc., 4 story, 66 x 98 ft. garage, 348 West 27th St., to I. Langner & Son, 60 East 42nd St. Est. $150,000.

Pa., Cannonsburg—West Pennsylvania Power Co., West Pennsylvania Bldg., Pittsburgh, 1 story, 80 x 95 ft., brick, concrete garage steel truss and beam covered with channel tile slab roofing, Pike at College Ave., to Sanderson & Porter, West Pennsylvania, Terminal Bldg., Greensburg. Est. $40,000.

Pa., Pittsburgh—See "Factories and Mills."

Pa., Pittsburgh—W. Bachr Motor Co., c/o R. M. Reutti, archt., Whitfield Bldg., 1 story, 90 x 100 ft., brick, steel garage, 5548 Center St., to C. L. Weissert, 2512 Cleveland Ave., McKeesport. Est. $40,000.

Ont., Toronto—City, in connection with Street Cleaning Dept., will construct new garage in North end of city, $30,000; extending garage and repair shop, Dundas St. E., $50,000; repairs to Don Incinerator, $75,000; men's lunch room and roadway at Wellington Incinerator, $22,000; repairs to Island Incinerator, $15,000. Work to be done partly by day labor and partly by contracts. R. C. Harris, City Hall, engr.

Ont., Toronto—Evening Telegram, Bay and Melinda Sts., general contract 2 story, brick, steel, concrete garage, Seaton St., to Deckie Constr. Co., 17 Yorkville Ave.; excav., to R. A. Johnstone, 88 Broadview Ave., plumbing and heating, to Fiddes & Hogarth, 122 King St. E.; electrical work to Moss Electric, 79 Adelaide St. E.; steel to Dominion Bridge Co., Ltd., 1139 Shaw St. Est. $100,000.

Ont., Toronto—Toronto Daily Star, 80 King St. W., general contract brick, steel, concrete garage, Albany Ave. and Dupont St. to Toms Constr. Co., 32 Phipps St.; excav. to Lioni & Co., Ltd., 69 Prescott Ave. Est. $100,000. General contractor to let electric wiring, steam heating contracts.

POWER PLANTS

PROPOSED WORK

N. Y., New York—New York Edison Co., 4 Irving Pl., plans by G. H. Kress, c/o owner, altering power plant, 700 East 15th St. $40,000.

N. D., Fargo — Armour & Co., 316 South LaSalle St., Chicago, Ill., soon takes bids boiler and stoker units for packing plant. To exceed $40,000.

Tex., Bogata—City, c/o Mayor, electric light plant, incl. distributing lines, power unit, $35,000.

BIDS ASKED

Pa., Pitcairn—Oct. 2, by W. H. Hicks, boro secy., Municipal Bldg., furnishing, erecting additional generating unit direct connected alternator of approximately 650 kw. at 80% power factor, 3 phase, 60 cycle, 2,400 volt, together with direct connected exciter and necessary equipment, bids on Diesel and natural gas engines.

CONTRACTS AWARDED

Ark., Siloam Springs—City, C. Harrington, mayor, 20 ft. ceiling, part basement, 40 x 60 ft., concrete, brick power plant, incl. two 375 hp. Diesel engines direct connected to General Electric generator, 7-panel switchboard with all instruments, two 20 gal. storage tanks, 2,500 ft. pipe for fuel with pump cooling tower, water softener, crane, to Trans-American Co., subsidiary McIntosh & Seymour Corp., c/o job $80,425, incl. interest payments from earnings for 66 months.

Md., Catonsville—H. P. Hopkins, archt., 10 East Mulberry St., Baltimore, rein.-con., brick, steel powerhouse-coal pocket railroad switch for Spring Grove State Hospital, to C. L. Stockhausen Co., Gay and Water Sts., Baltimore alterations to Insane Building, to Thos. Hicks & Son, 107 West Madison St., Baltimore. Noted Aug. 28 Daily.

Neb., Fremont—Bd. P. Wks., J. R. Henry chn., one 2,500 kw. 312 k.v.a. turbo-generator, to General Electric Co., 610 Electric Bldg., Omaha, $47,000; one 3-pass. surface condenser, to C. H. Wheeler Co., 19th St. and Lehigh Ave., Phila., Pa., $9,980; one 40 kw. motor driven exciter, to Fremont Fdry. & Mchy. Co., Fremont, $1,386. Grand total $58,366.

SHOPS AND FOUNDRIES

PROPOSED WORK

Ill., Aurora—SHOPS—Chicago, Burlington & Quincy R.R. Co., 547 West Jackson Blvd., Chicago, A. W. Newton, ch. engr., rebuilding shops, destroyed by fire. $350,000.

Mass., Dorchester — SHOP — Massachusetts Auto Serv., 1228 Massachusetts Ave., plans by E. E. Bossi, 117 East Cottage St. and soon takes bids 1 story, 60 x 150 ft. concrete, steel auto repair shop, concrete found., 1236 Massachusetts Ave. $40,000.

O., Girard—SHOPS—Pennsylvania R.R., T. J. Skillman, ch. engr., Broad St. Sta., Phila., Pa., shops. $500,000. **Maturity indefinite.**

BIDS ASKED

N. Y., Syracuse—SHOP—Syracuse Lighting Co., 421 South Warren St., taking bids maintenance and service building, Erie Blvd. $500,000.

CONTRACTS AWARDED

Mass., Springfield—MACHINE SHOP— Moore Drop Forging Co., 38 Walter St., 1 story, 80 x 150 ft., brick, steel, concrete footing, Wason Ave., to A. J. Daniels, 661 Main St., Shrewsbury. Est. $40,000.

WAREHOUSES

PROPOSED WORK

Mass., Chelsea—Panco Rubber Co., M. Birstein, 31 Highland Ave., plans by S. Schein, 333 Washington St., Boston, 2 story, basement, 75 x 85 ft., concrete, steel storage building, concrete found., Highland St. and Congress Ave. $40,000 or more.

Mass., Worcester—Northeastern Storage & Distributing Corp., J. Gerety, 93 Grafton St., 180 x 640 ft., brick, steel, concrete storage warehouse terminal, Grafton and Keefe Sts. $900,000. Project in abeyance. Howe & Lescaze, 337 East 42nd St., New York, archts. Noted June 11.

N. Y., Brooklyn—C. W. & P. C. Heidleberger, 180 Franklin St., plans by W. B. Wills, 28 Adams St., Floral Park, storage, manufacturing and loft building, Meserole and Manhattan Aves. $40,000.

N. Y., New York—New York State Realty & Terminal Co., Grand Central Terminal or c/o New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., 7 story, 81 x 163 ft., storage, terminal, 82 Gansevoort St., 89 Horatio St. and 802 Washington St. $350,000. **Maturity in winter.** J. B. Snook Sons, 52 Vesey St., archts. Noted Sept. 10.

N. Y., New York—Old Reliable Fur Co., Lessee, 150 West 34th St., altering storage, workroom, store and loft, 126 West 34th St. To exceed $40,000.

BIDS ASKED

N. J., Newark—Wilkinson Gaddis & Co., 95 Parkhurst St., bids about Nov. 1, general contract 5 story, basement, brick, steel grocery warehouse, office. $500,000. Epple & Kahrs, 15 Washington St., archts. Noted Sept. 17.

Wis., Green Bay—Atlas Cold Storage Warehouse Co., E. R. Fisher, pres., taking bids brick, rein.-con. cold storage warehouse. $40,000. Private plans.

CONTRACTS AWARDED

Mich., Detroit—Detroit Union Produce Terminal Co., West Fort St., 2 story (ultimately several more stories), part basement, 110 x 400 ft., rein.-con. flat slab warehouse, plain found., to Bryant & Detwiler Co., 2806 Union Guaranty Bldg., est. $170,000.

N. J., Hawthorne—Great Atlantic & Pacific Tea Co., 420 Lexington Ave., New York, 125 x 300 ft. distribution, cold storage plant, to Austin Co., 120 Bway, New York. Est. $250,000.

N. C., Durham—American Suppliers, Inc., three 1 story warehouse units, Alston Ave. Rd., to Fiske-Carter Constr. Co., Durham. $150,000.

Okla., Oklahoma City—J. I. Case Co., Racine, Wis., 40 x 100 ft., storage warehouse and distribution system, to Ellis Nicholson & Cramer, Security Bldg., Est. exceeds $40,000, incl. equipment.

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See proposed advertising on page 99